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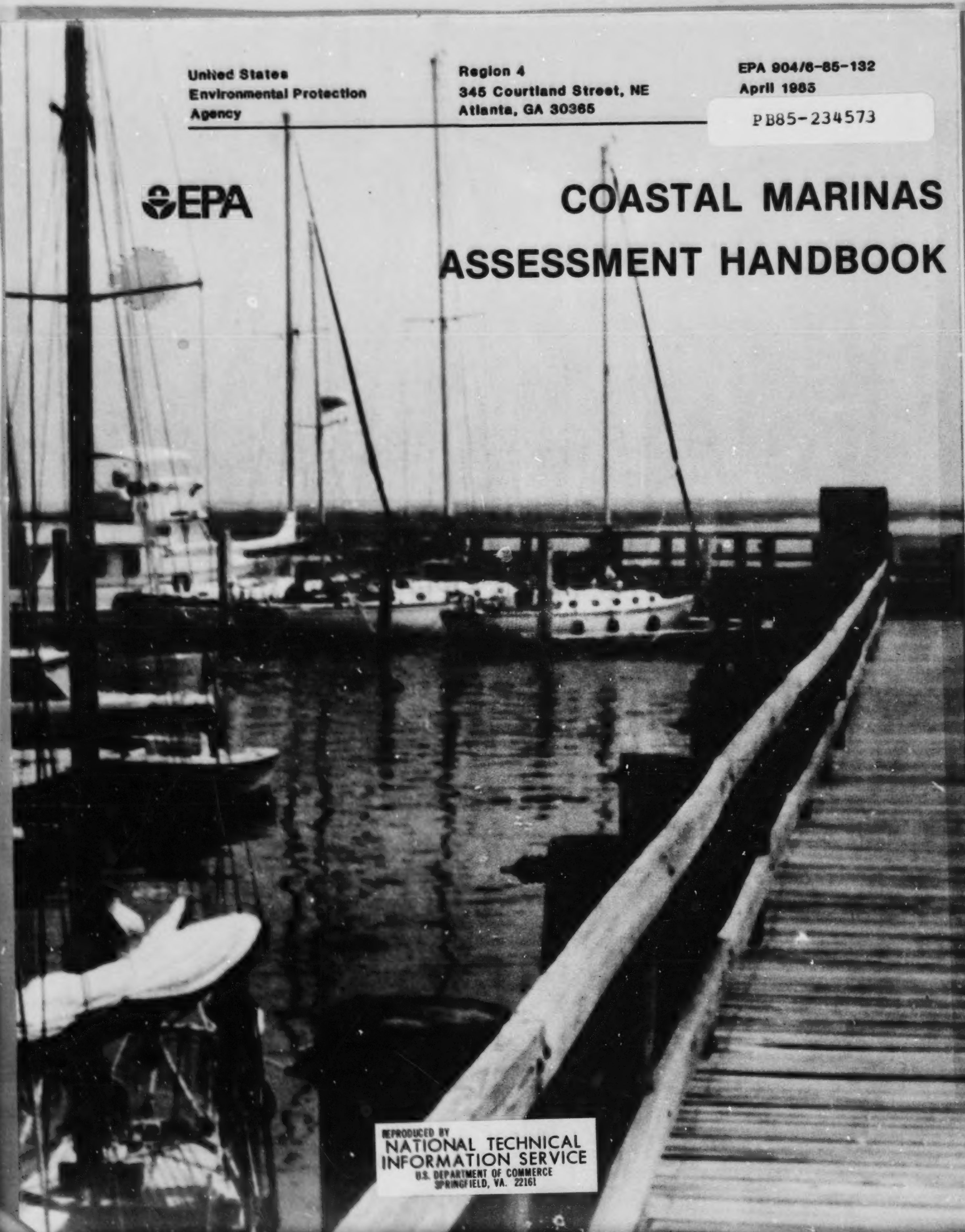
COASTAL MARINAS ASSESSMENT HANDBOOK



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The Coastal Marinas Assessment is a handbook of information and guidance for the environmentally sound development and regulation of coastal marinas. The handbook provides assistance and identifies options for the resolution of environmental, institutional and engineering issues associated with coastal marina development. The document provides state-of-the-art information and is designed to be periodically updated.

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COASTAL MARINAS ASSESSMENT HANDBOOK

APRIL 1985

Prepared by

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV - ATLANTA

With Assistance from

APPLIED BIOLOGY, INC.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

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Inquiries regarding information in this handbook should be made to U.S. Environmental Protection Agency, Region IV, Environmental Assessment Branch, 345 Courtland Street, Atlanta, Georgia, 30365.

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TABLE OF ACRONYMS

AEC - Area of Environmental Concern
ATM - Atmosphere
BCDC - Bay Conservation and Development Commission (San Francisco)
BMR - Bureau of Marine Resources (MS)
BOD - Biochemical Oxygen Demand
BPC - Bureau of Pollution Control (MS)
CAMA - Coastal Area Management Act (NC)
CMPC - Coastal Marshlands Protection Commission (NC)
CMPC - Coastal Marshlands Protection Commission (GA)
COD - Chemical Oxygen Demand
COE (Corps); USACOE - United States Army Corps of Engineers
CRC - Coastal Resources Commission
CRD - Coastal Resources Division (GA-DNR)
CWA - Clean Water Act
dBA - Decibels adjusted to the A - scale compatible with human hearing capabilities
DCA - Department of Community Affairs (FL)
DCNR - Department of Conservation and Natural Resources (AL)
DEM - Department of Environmental Management (AL)
DEM - Division of Environmental Management (NC)
DER - Department of Environmental Regulation (FL)
DHEC - Department of Health and Environmental Control (SC)
DNR - Department of Natural Resources (GA, FL, MS)
DNRCD - Department of Natural Resources and Community Development (NC)
DO - Dissolved Oxygen
DOT - Department of Transportation
DRI - Development of Regional Impact
EIS - Environmental Impact Statement
EPA; USEPA - United States Environmental Protection Agency
EPD - Environmental Protection Division (GA)
F&W; USFWS - United States Fish and Wildlife Service
FAC - Florida Administrative Code
FDA - Food and Drug Administration
FONSI - Finding of No Significant Impact
MPN - Most Probable Number
MSD - Marine Sanitation Device
NMFS - National Marine Fisheries Service
NPDES - National Pollution Discharge Elimination System
NPP - Net Primary Production
NSSP - National Shellfish Sanitation Program
OCM - Office of Coastal Management (NC)
OCZM - Office of Coastal Zone Management
OMB - Office of Management and Budget
POC - Public Oyster Ground
PCB - Polychlorinated biphenyl
PVC - Polyvinyl chloride
SDD - State Docks Department (AL)
SHPO - State Historic Preservation Office (AL)
SOS - Secretary of State (MS)
SSCA - State Shellfish Control Agency
SCCC - South Carolina Coastal Council
TOC - Total Organic Carbon
USCG - United States Coast Guard
USGS - United States Geological Survey

VARIABLES USED IN EQUATIONS

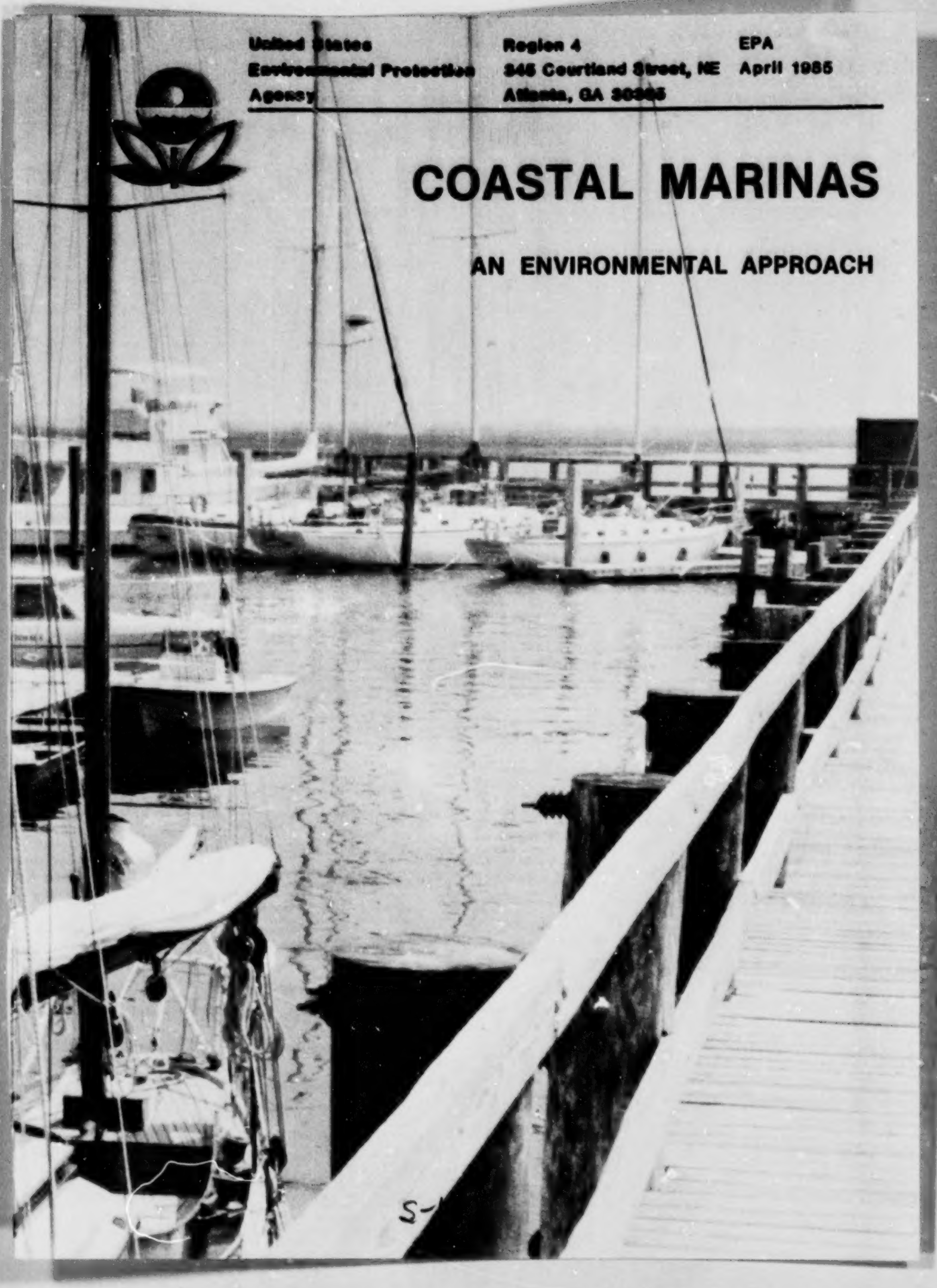
Symbol	Definition	First used in equation
T_f	Flushing time (hrs)	1,2
Tc	Tidal cycle, high tide to high tide (hrs)	
A	Surface area of marina basin (m^2)	
D	Desired dilution factor	
R	Range of tide (m)	
b	Return flow factor	
I	Non-tidal freshwater inflow (m^3/hr)	
L	Average depth at low tide (m)	
H	Average depth at high tide (m)	
V_L	Volume of marina at low tide (m^3)	3
V_H	Volume of marina at high tide (m^3)	
V_P	Volume of marina tidal prism (m^3)	
S_w	Sea water salinity (ppt)	4
S_i	Mean salinity in segment (ppt)	
V_i	Volume in segment (m^3)	
I	River discharge (m^3/hr)	
n	number of segments	
F_5	0.024-converts units to kg/day	5
S_s	Suspended load sedimentation rate (kg/day)	
V_m	Volume of marina at mean depth (m^3)	
TSS	Total suspended solids in waters draining into marina (mg/l)	
V_r	Volume of runoff (liters)	6
U_r	Unit runoff (in)	
A_d	Drainage area (acres)	
i	Subdivision of drainage area used to determine soil group and RCN	
F_6	102802 - converts units to liters	
RCN	Runoff curve number	
S_r	Runoff sedimentation rate (g/day)	7
$\bar{V}_r$	Average daily V_r (l/day)	
F_7	1 x 10^3 - converts units to gm/day	
TSS	Total suspended solids (mg/l)	
R_s	Shoaling rate (m/year)	8
F_8	3.65 x 10^4 - converts units to (m/year)	
ρB	Bulk density of sediments (g/cm^3)	
TSS_d	Total suspended solids increase due to dredging (mg/l)	9
V_D	Volume of sediment disturbed (m^3)	
r	Resuspension factor for sediment type	
W_d	Dry weight of sediment (g/m^3)	
V_m	Mean volume of marina waters (m^3)	
F_{10}	1 x 10^{-6} - converts units to m	
S	Shoaling as a result of redistribution (m)	10
C_t	Concentration of pollutant at time t (mg/l)	11
C_A	Ambient concentration of pollutant prior to addition of discharge (mg/l)	
M	Mass of pollutant discharged into basin (mg)	
k	Decay rate for non-conservative pollutants (day^{-1})	
t	Time (days)	
F_{11}	1000 - converts units to mg/l	
N	Number of tidal cycles - 24 /T_c	
C	Concentration of pollutant (mg/l)	12

VARIABLES USED IN EQUATIONS
(continued)

Symbol	Definition	First used in equation
M_r	Mass flow rate of pollutant into basin (mg/day)	
F_{12}	4.17×10^{-5} - converts units to mg/l	
j	$T_f/24$	13
DO_R	Approximate [DO] remaining (mg/l)	14
DO_A	Ambient [DO] of water flushing into marina (mg/l)	
DO_S	Saturated [DO] (mg/l)	
DO_L	Dissolved oxygen concentration in marina at low tide (mg/l)	
k_1	Reaeration coefficient (day^{-1})	
B	Sediment oxygen demand ($mg/m^2/day$)	
C_B	Biochemical oxygen demand mass discharge (mg/day)	
F_{14}	1000 - converts m^3 to l	
C_N	Nitrogenous oxygen demand (mg/l)	
C_o	Cross sectional average concentration in segment (mg/l)	15,16,17
C_d	Concentration of the pollutant down-estuary at a distance x (mg/l)	
Cu	Concentration of the pollutant up-estuary from the marina at distance x (mg/l)	
Q_p	Mass of pollutant discharged per tidal cycle (mg)	
I_s	Sum of freshwater Q into estuary per tidal cycle (m^3)	
S_x	Salinity in segment at distance x (ppt)	
W	Discharge rate of pollutant (mg/day)	18,19
A_x	Cross sectional area of estuary at point x (m^2)	
U	Freshwater flow velocity near discharge (m/day)	
F_{18}	1×10^{-3} - converts units to mg/l	
E	Dispersion coefficient (m^2/day)	
X	Distance from marina (m)	
$\overline{S}$	Tidally and cross sectionally averaged salinity in vicinity of marina (ppt)	20
Δx	Distance from marina at which salinity measurements were made (m)	
$S_{x+\Delta x}$	Salinity at distance x down the estuary (ppt)	
$S_{x-\Delta x}$	Salinity at distance x up the estuary (ppt)	
DO_D	Dissolved oxygen deficit (mg/l)	21
k_2	BOD decay rate	22
W_L	BOD from discharge plus background BOD (mg/l)	
Z_1	$U^2 + 4k_2E$	
Z_2	$U^2 + 4k_1E$	
C_x	Concentration of pollutant at point x downstream (mg/l)	23,24
X_R	Distance downstream of marina (m)	
Q	Volumetric river flow rate (m^3/day)	
H_r	Depth of flow (m)	
D_L	Diffusivity of oxygen in water = $7.53 \times 10^{-6} m^2/hr$ at 20°C	
U_v	River velocity (m/hr)	
G	Number of boats	25
P	2.5×10^9 coliforms/boat	
F_{25}	1×10^4 - converts units to MPN/100 ml	

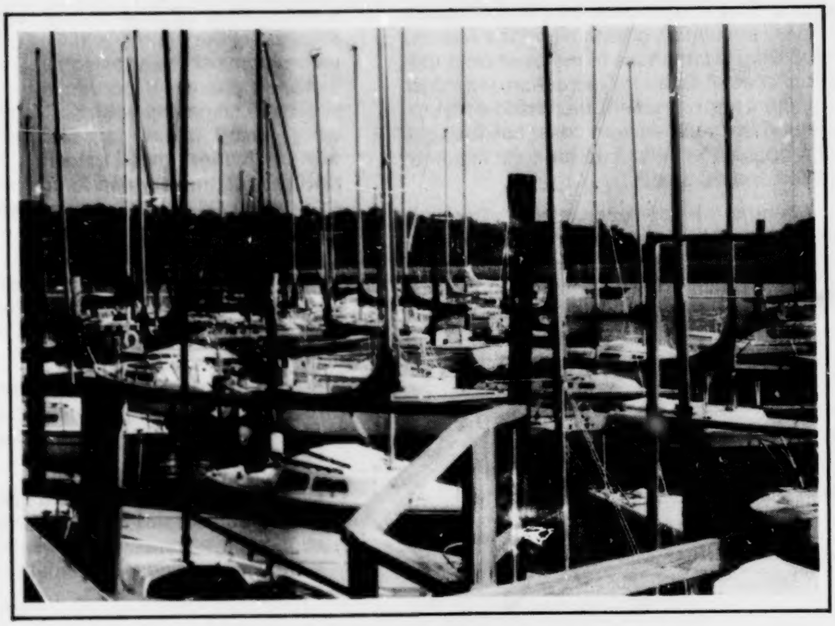
METRIC-ENGLISH CONVERSION TABLE

To convert	Multiply by	To obtain
Celsius (degrees)	(°C x 1.8) + 32	Fahrenheit (degrees)
Celsius (degrees)	°C + 273.18	Kelvin (degrees)
centimeters (cm)	3.937×10^{-1}	inches
centimeters (cm)	3.281×10^{-2}	feet
centimeters/second (cm/sec)	3.281×10^{-2}	feet per second (ft/sec)
cubic centimeters (cm^3)	1.0×10^{-3}	liters
cubic meters (m^3)	1.0×10^{6}	cubic centimeters
cubic meters (m^3)	3.531×10^{1}	cubic feet
cubic meters/day (m^3/day)	2.642×10^{-4}	million gallons/day (mgd)
grams (g)	2.205×10^{-3}	pounds
grams (g)	3.527×10^{-2}	ounces (avoirdupois)
hectares (ha)	2.471	acres
kilograms/square meter	2.896×10^{-3}	inches of mercury (in. Hg)
kilograms (kg)	1.0×10^{3}	grams
kilograms (kg)	2.2046	pounds
kilograms (kg)	3.5274×10^{1}	ounces (avoirdupois)
kilometers (km)	6.214×10^{-1}	miles (statute)
kilometers (km)	1.0×10^{6}	millimeters
liters (l)	1.0×10^{3}	cubic centimeters (cm^3)
liters (l)	2.642×10^{-1}	gallons (U.S. liquid)
meters (m)	3.281	feet
meters (m)	3.937×10^{1}	inches
meters (m)	1.094	yards
microns (μ)	1.0×10^{-6}	meters
milligrams (mg)	1.0×10^{-3}	grams
milligrams/liter (mg/l)	1.0	parts per million (ppm)
milliliters (ml)	1.0×10^{-3}	liters (U.S. liquid)
millimeters (mm)	3.937×10^{-2}	inches
millimeters (mm)	3.281×10^{-3}	feet
milliliter/liter	1.0	parts per thousand (ppt)
square centimeters (cm^2)	1.550×10^{-1}	square inches
square meters (m^2)	1.076×10^{1}	square feet
square millimeters (mm^2)	1.55×10^{3}	square inches



COASTAL MARINAS

AN ENVIRONMENTAL APPROACH



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

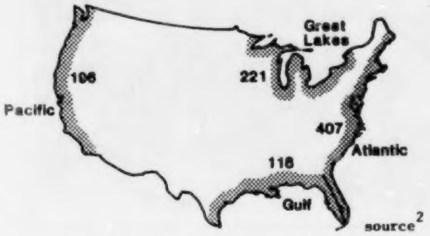
S-2

INTRODUCTION

This booklet introduces the
Coastal Marinas Assessment Handbook,
a handbook of information for the development and regulation of coastal marinas in an environmentally sound manner.

The coastal zone supports more than fifty percent of the U.S. population and this percentage is increasing. This is especially true in the Southeast where population growth along the Atlantic and Gulf Coasts continues to increase from utilization of coastal areas for recreation, industrial development and retirement. Increased development along the southeastern coast has brought about a population influx into formerly sparsely populated coastal areas.

- For example, the population in North Carolina coastal counties increased by 18 percent between 1970 and 1980, while the number of registered boats in these counties increased by 86 percent between 1973 and 1983.



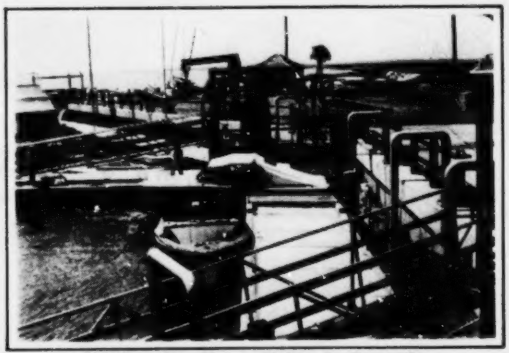
Population density along major coasts (persons/sq. mile)

This growth has resulted in an ever increasing demand for recreational boating facilities. Coastal marinas are important in meeting the demand for access to coastal waters.

In addition to being highly desirable commercial and recreational resources, southern coastal areas provide valuable natural resources. Estuaries along the Atlantic and Gulf coasts support extensive marshes and mangrove wetlands. These wetlands provide important nursery areas for sport and commercial fish and shellfish, most of which spend at least part of their life cycles in these estuaries. These estuaries and wetlands also provide nursery and forage areas for birds and other wildlife and support many protected plants and animals.

- Approximately 90 commercial fish species, including seven of the ten most valuable, depend on coastal waters at one or more stages in their life cycle.[2]
- 60 percent of the annual U.S. marine commercial harvest and 64 percent of the marine recreational catch consist of estuarine-dependent species.[1]

Coastal areas are sensitive to impacts because coastal ecosystems are limited in their ability to support development and recreational activities without sustaining detrimental changes in the ecological balance.



Fueling for day cruising in Georgia

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[1] Natural Resources Defense Council, Inc. 1976. Who's minding the shore? Prepared for Office of Coastal Zone Management, Washington, D.C. 51 pp.

[2] Council on Environmental Quality. 1983. 14th Annual Report of the Council on Environmental Quality, Washington, D.C. 341 pp.

5-3

Steadily increasing recreational and commercial utilization of these coastal areas has heightened the concern for protecting and conserving the natural and aesthetic resources; the very resources that attract people to the coast.

- 60 percent of America's threatened or endangered species live in the coastal zone.[2]
- Each year 2,500 acres of wetlands are lost in the Southeastern States due to population growth and urbanization, energy development, industrial development and recreational activities.[1]

Overall increased development throughout the coastal zone in conjunction with increasing demand for recreational marina facilities has led to progressively complex issues that must be resolved by governmental agencies, marina developers and coastal residents. These issues are related to the need to protect the sensitive coastal environment, while preserving or enhancing multiple uses of valuable coastal resources.

Coastal Marinas Assessment Handbook is an up-to-date and comprehensive handbook of information that addresses many of these environmental issues. The Handbook was developed by EPA Region IV to provide guidance to marina developers and regulatory agencies for the development of coastal marinas in an environmentally sound manner. Although developed specifically for the Region IV States, much of the information in the Coastal Marinas Handbook is applicable nationwide.

The following sections introduce many complex and interrelated issues associated with present-day marina development. For more information the reader is encouraged to obtain a copy of the Handbook and to contact the applicable agencies listed on the last page of this booklet.

Marina expansion/condominium development in South Carolina

COASTAL MARINAS IN REGION IV

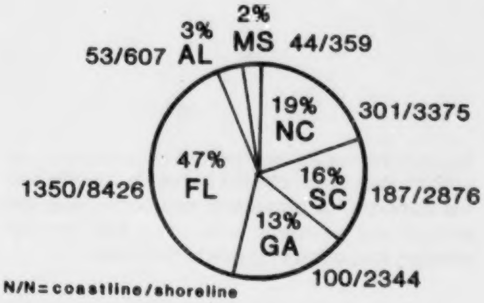
The six Coastal States of EPA Region IV provide almost 18,000 miles of shoreline.[3] The innumerable estuaries, sounds, bays and tidal rivers invite exploration by recreational boaters. Approximately 930 marinas presently serve recreational boaters along the coast in Region IV.

Increased recreational use of coastal waters is evident throughout the Southeast. From 1980 to 1985 coastal marinas in South Carolina increased from 12 to 35 with 24 pending permits. In Florida, demand for coastal berthing facilities is projected to increase by 63 percent between 1982 and 2005.

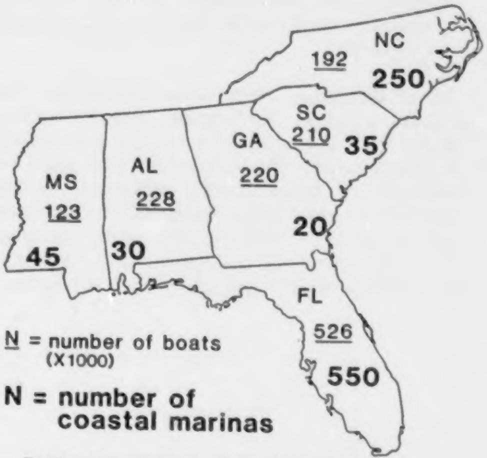
Along the Intracoastal Waterway in Region IV, Florida and North Carolina have the largest number of marinas serving cruising boats of at least 25 feet in length. Most of the marinas serve both power and sailboats year-round. These marinas provide the opportunity for overnight docking or permanent liveaboards. Services offered include engine, propeller and hull repair, fuel, electricity, sanitary services and food.

In addition to their value in providing protected moorage for boats, coastal marinas provide many social and economic benefits including:

- Access to coastal waters
- Focal points for community activities
- Focus for upland development
- Tax revenues for local communities
- Revenue for owners and the broader marine industry
- Employment opportunities.



Proportion of shoreline in Region IV coastal states



Estimated numbers of coastal marinas and registered boats in Region IV coastal states

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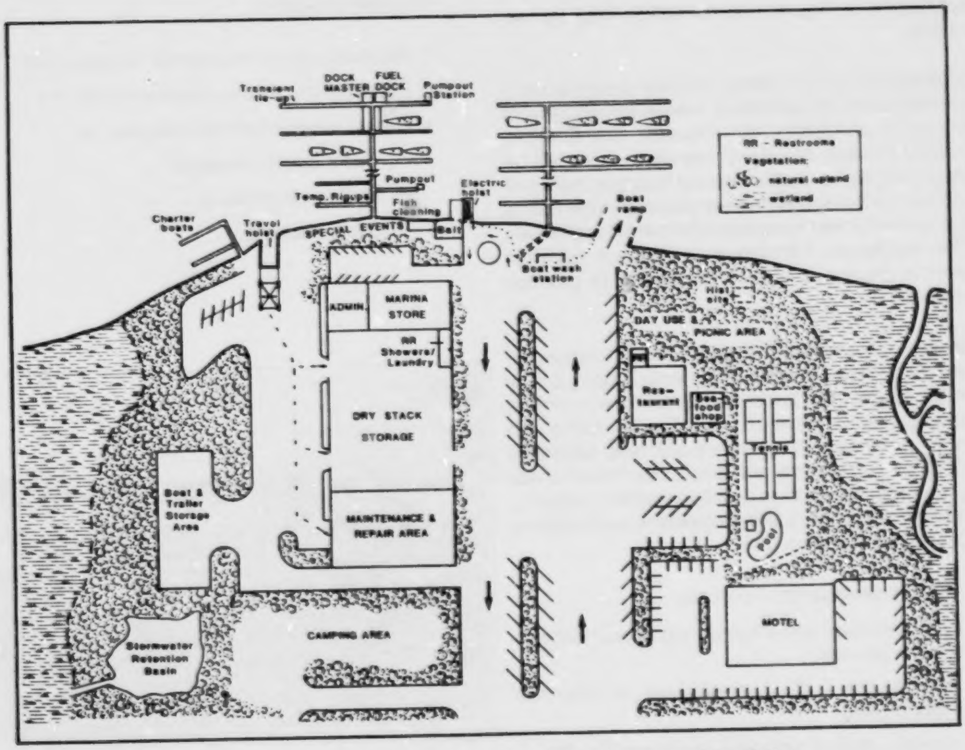
[3] Newspaper Enterprise Association, Inc., 1984. The World Almanac 1985. NEA, New York.

Environmental impacts from coastal marina construction and operation may be temporary or long-term. Adverse impacts may result from:

- Dredging and dredged material disposal
- Placement and design of shoreline and protective structures
- Wastewater discharge and stormwater runoff
- Boat operation and maintenance.

The potential for adverse environmental impacts is a function of many variables including marina location, design, services offered and number and type of boats served. Therefore, the potential for adverse environmental change is not the same for all marinas. The potential for adverse impacts can be heightened when marina siting, design and management is not based on sound environmental principles.

The demand for recreational marinas is high in the coastal area and will continue to increase. The challenge is to meet this demand through prudent application of environmentally sound principles in the siting, design, construction and operation of coastal marinas. The Coastal Marinas Handbook provides guidance for meeting this challenge.


Transient tie-ups
DOCK MASTER
FUEL DOCK
Pumpout Station
Pumpout
Temp. Tie-ups
Fish cleaning
Electric hoist
Boat ramp
Charter boats
Travel hoist
SPECIAL EVENTS
Bait
Boat wash station
RR - Restrooms
Vegetation:
natural upland
wetland
ADMIN.
MARINA STORE
RR Showers/ Laundry
Hist. site
DAY USE & PICNIC AREA
Res-taurant
Sea-food shop
DRY STACK STORAGE
Tennis
Pool
Boat & Trailer Storage Area
MAINTENANCE & REPAIR AREA
MOTEL
Stormwater Retention Basin
CAMPING AREA

Types of marina services and functional relationship of facilities

COASTAL MARINAS: THE ENVIRONMENTAL APPROACH

The Coastal Marinas Handbook examines the major aspects of coastal marina development:

- Siting
- Environmental impacts
- Environmental solutions
- Regulation.

Each of these topics is broad in scope and is discussed in consecutive chapters of the Handbook.

Handbook organization follows the typical marina development process. This organization provides the user with a stepwise approach to environmentally sound marina development from siting considerations through environmental solutions applicable during marina operation and maintenance.

Information in the Siting chapter permits early identification of permitting issues resulting from potential environmental impacts; the Environmental Impacts chapter presents techniques for assessing these environmental impacts; the Environmental Solutions chapter provides alternative measures for resolving potential permitting issues. The regulatory framework for marina development in Region IV is described in the Regulation chapter.

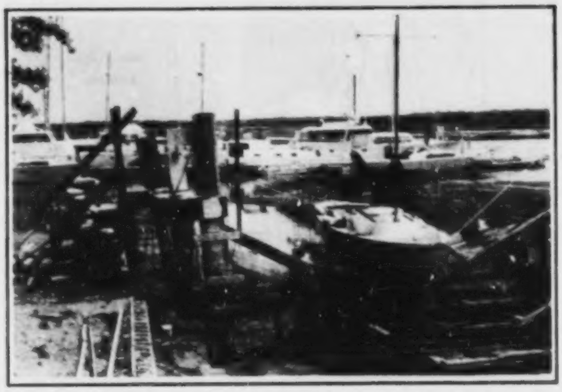
Siting — Site selection based upon a clear understanding of potential environmental impacts may be the single most important factor for successful coastal marina development. Proper siting can avoid many permitting issues and help eliminate costly environmental solutions. The Siting chapter provides the marina developer with a guide for site planning prior to initiating permit applications. Topics discussed include:

- Marina development process
- Environmental and engineering considerations for site planning
- Advantages and disadvantages of potential marina sites
- Identification of potential permitting issues.

Environmental Impacts — Environmentally sound marina development can best occur when potential impacts are assessed early enough in the coastal marina development process to allow for solutions in the planning and design phases of marina development. The Environmental Impacts chapter provides the marina developer, design engineer and regulator with impact assessment techniques that can be used to evaluate potential environmental impacts for proposed marina sites or design configurations.

The techniques presented provide reasonable approximations for screening potential impacts. These techniques also can be used in evaluating marina permit applications or to evaluate the operational performance of the coastal marina. Topics discussed include:

- Approach to environmental assessment
- Potential impacts to coastal resources
- Impact assessment techniques for:
  - Water quality impacts
  - Ecological impacts
  - Other impacts.



Problem area: Hull repair at the water's edge

Environmental Solutions — Following proper siting, the ultimate environmental performance of a marina depends on the design, construction and operation of the facility. Although many environmental impacts can be avoided through marina siting and design, unavoidable impacts can occur. The Environmental Solutions chapter provides the marina planner, developer and regulator with optional solutions for:

- Water quality impacts
- Ecological impacts
- Other impacts.

The various options serve as a source for impact mitigation during:

- Marina design and construction
- Marina operation and maintenance.

Regulation — Marina permitting processes vary considerably within EPA Region IV. The marina developer can use information in the Regulation chapter to identify the principal permitting and review agencies and agency concerns for impacts to specific coastal resources. Permit application and review processes for each Region IV coastal state are summarized. Additional guidance includes:

- Regulatory/planning processes and agency responsibilities
- Functional roles of Federal, State and Local agencies
- Basis for decision-making
- Actions required of the marina developer in obtaining a permit.

The Coastal Marinas Handbook also includes:

- A detailed bibliography of related literature
- Sample permit application forms
- Permit evaluation criteria
- Examples of measurement methods for marina environmental assessment
- Examples of ordinances now being enacted by local governments to regulate the marina industry.

Environmental Solution: Use of upland area for boat maintenance

S-8

SITING THE COASTAL MARINA

Many permitting problems and costly delays in obtaining permits can be avoided by selecting an environmentally sound marina site. The information in the Siting chapter assists the coastal marina developer in obtaining an overview of the advantages and problem areas associated with specific marina sites. This overview is provided by a screening checklist designed to flag potential permitting issues that could adversely affect marina permit approval. These issues involve:

- Wetland resources
- Shellfish resources
- Protected habitats and species
- Existing water quality
- Marina flushing potential
- Navigation
- Public access
- Existing regulations, rules, policies or guidelines
- Local opinion
- Historic/archaeological resources

The checklist also is useful for identifying areas where additional information may be needed. It is keyed to subsequent sections of the Handbook that present environmental assessment techniques and alternative environmental solutions to marina impact problems. The Handbook addresses the relationship of marina construction and operation activities to these issues.

Maximum use of natural coastal features can minimize potential environmental impacts. Almost any coastal site can be made into a marina, but generally the more extensive the required modifications, the greater the construction costs and potential for environmental impacts. The Siting chapter describes site characeristics that can make candidate marina sites more desirable or less desirable.

ENVIRONMENTAL IMPACT CONSIDERATIONS

Impact Source Considerations	Water Quality										Ecological									Other						
	Turbidity	Dissolved Oxygen	Nutrients	Bacteriological	Metals	Hydrocarbons	Toxic Substances	Other Pollutants	Erosion	Hydrological	Endangered Species	Birds/Rookeries	Benthos	Shellfish	Other Aquatic Organisms	Grassbeds	Wetlands	Nursery Areas	Terrestrial Habitats	Aesthetics	Historical/Archaeological	Navigation	Marina Resources	Local Economy	Local Land Use	Public Access
Marina Location										S	S	S		S		S	S	S	S	S	S	S	S	S	S	S
Marina Size & Services																							S	S	S	S
Dredging	S	S	S		S	S	S	S		S	S		S	S	S	S	S	S								
Spoil Disposal	S	S			S	S					S	S	S	S	S	S	S	S	S	S						
Filling	S	S	S					S		S	S	S	S	S	S	S	S	S	S	S						
Grading & Clearing	C		C						C			C							C	C						
Hydrological Modification	D	D	D	D	D	D	D	D		D							D					D				
Structures									D	D				D			D	D	D			D				
Point Wastewater Discharge	D	D	D	D	D						D		D	D						D						
Non-point Source Runoff	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D						
Boat Operation	E								E		E			E		E	E	E		E						
Boat Discharges		E	E	E										E						E						
Spills						O						O	O	O	O			O		O						
Boat Maintenance			E			O	O	O						O												
Litter											E									E						
Noise												O								O						

Primary Environmental Solutions

S = Environmentally Sound Marina Site Selection
D = Design of Marina with Environmental Considerations
C = Environmentally Guided Marina Construction Techniques
O = Proper Operation and Maintenance of Marina Systems and Boats
E = Enforcement of Rules and Regulations and Education of Marina Users in the Environmental Impacts or Their Actions

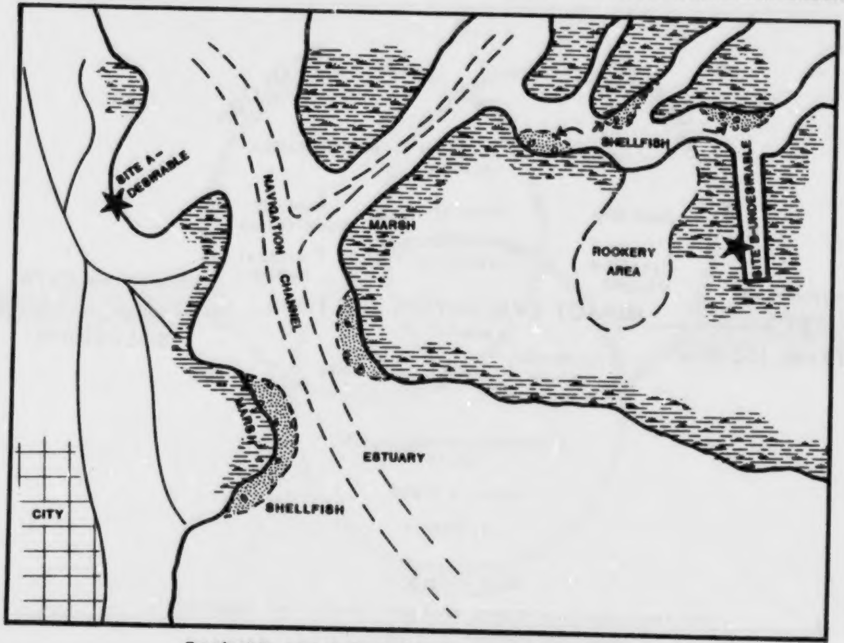
Impact source considerations and primary environmental solutions for water quality, ecological and other impacts

Desirable site characteristics include:

- Within easy access to open waters, population centers, utilities, public sewer and water lines
- Accessible from existing roads and waterways
- On sheltered waters providing adequate storm protection with deep waters close to shore
- Near existing state or federally maintained channels
- Near currently permitted public areas for disposal of dredged material
- High tidal range or flow and high flushing rates such as near the mouths of estuaries or tidal creeks, near inlets or on convex shorelines
- Compatibility with existing land and water uses
- Away from shellfish beds used for harvesting for human consumption.

Undesirable site characterisitcs include:

- Too shallow or with inadequate water or land area for intended use, requiring extensive dredging or filling
- Low tidal range or flow and low flushing rates, such as dead-end channels or canals or the upper reaches of tidal creeks
- In a location with poor water quality, marginally meeting state water quality standards
- Near specially designated fish or wildlife protection areas or near shellfish beds or grassbeds
- The presence of rare, threatened, endangered or otherwise designated unique or outstanding aquatic or terrestrial species or habitats
- On or adjacent to recognized historic, archaeological or scenic resources
- Inhibiting public access to navigable waters or hindering safe navigation by requiring structures that would extend into existing channels.



Desirable and Undesirable Marina Sites A and B

ENVIRONMENTAL IMPACTS OF MARINA DEVELOPMENT

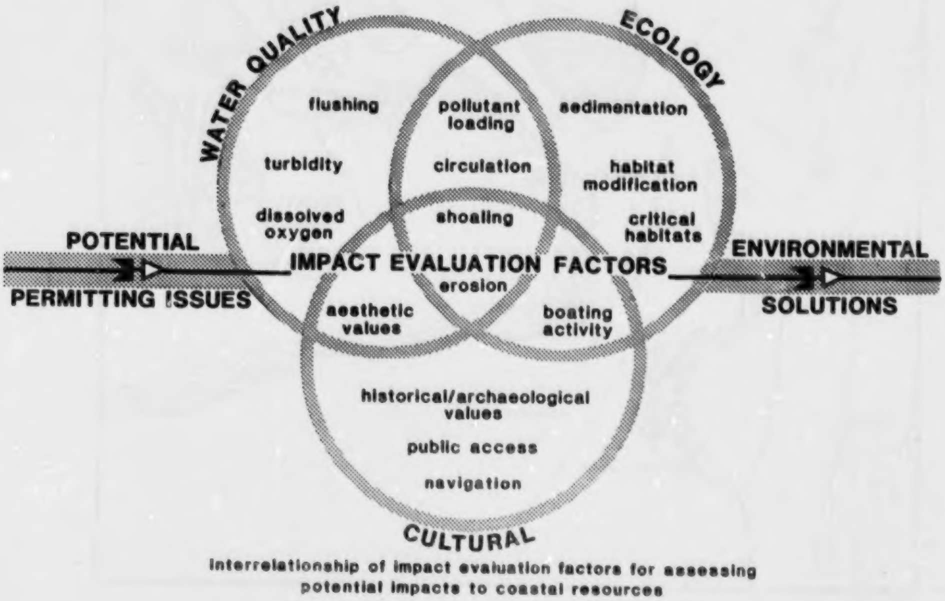
The potential for environmental impacts and their significance are a function of marina design and operational characteristics. The potential will not be the same for every marina. Basic environmental assessment techniques can be reasonably applied in screening potential environmental problem areas. The Environmental Impacts chapter provides basic techniques for use in evaluating proposed marina sites, marina design configurations or marina permit applications.

The impact assessment techniques contained in the Handbook provide reasonable approximations for screening problem areas when site-specific data are not available. Complex computer models that require interpretation by an expert familiar with the model are not discussed, although these techniques may be necessary in order to make a final determination of the significance of problem areas identified during initial screening.

Impact assessment techniques provided in the Handbook cover three broad areas:

- Water quality impacts
- Ecological impacts
- Other impacts.

Many of the activities in a marina, such as dredging, wastewater disposal, fueling operations and boat maintenance may affect the water quality in the marina basin and adjacent waters. These impacts can result from the discharge or accumulation of pollutants, nutrients, oxygen-demanding wastes or sanitary wastes. Therefore, flushing and circulation are important characteristics to be considered in marina planning and design. Two to four day flushing times are generally considered satisfactory.

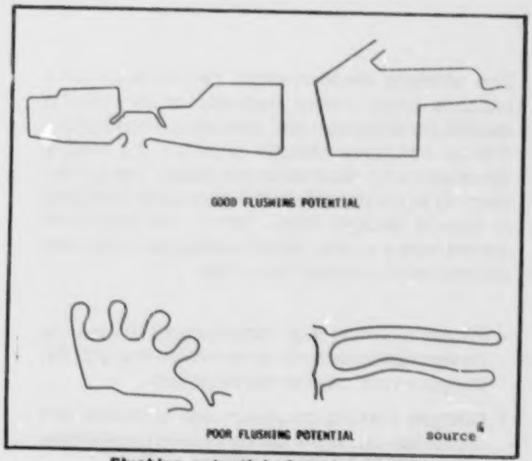

WATER QUALITY
ECOLOGY
flushing
pollutant loading
sedimentation
turbidity
circulation
habitat modification
dissolved oxygen
shoaling
critical habitats
POTENTIAL
PERMITTING ISSUES
IMPACT EVALUATION FACTORS
erosion
ENVIRONMENTAL
SOLUTIONS
aesthetic values
boating activity
historical/archaeological values
public access
navigation
CULTURAL

Interrelationship of impact evaluation factors for assessing potential impacts to coastal resources

In the Handbook, methods are presented for estimating flushing time, sediment deposition and shoaling rates and sedimentation from construction. Dilution and dispersion methods for estimating pollutant concentrations in open and semi-enclosed marinas are presented. Empirical methods and dye studies that may be used to estimate waste contribution from boats are discussed.

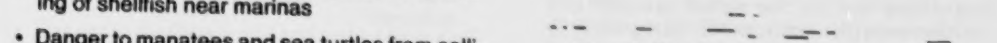
Guidance is given on how to consider the significant ecological impacts. These impacts include:

- Effects of construction, boat operation and pollutants on shellfish, grassbeds and water quality
- Presence of protected species or habitats on or near the marina site
- Increased fecal coliform concentrations affecting the commercial and recreational harvesting of shellfish near marinas
- Danger to manatees and sea turtles from collisions with boats
- Effects on historical/archaeological, aesthetic and navigation resources.



source[4]

Flushing potential of marina basins



Manatee injured by boat propeller

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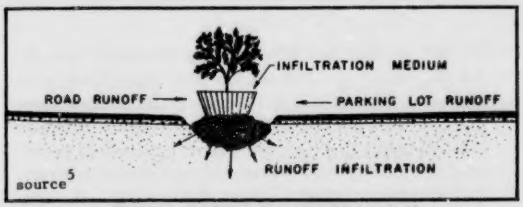
[4] South Carolina Coastal Council. Guidelines for preparation of coastal marina report. Charleston, S.C.

ENVIRONMENTAL SOLUTIONS TO MARINA IMPACT

The ultimate environmental performance of a properly sited marina depends on the marina design, construction and operation. The Environmental Solutions chapter provides the marina developer with alternative measures that can be used to solve potential environmental problems in marina design, construction, operation and maintenance as they affect water quality, ecological and other coastal resources.

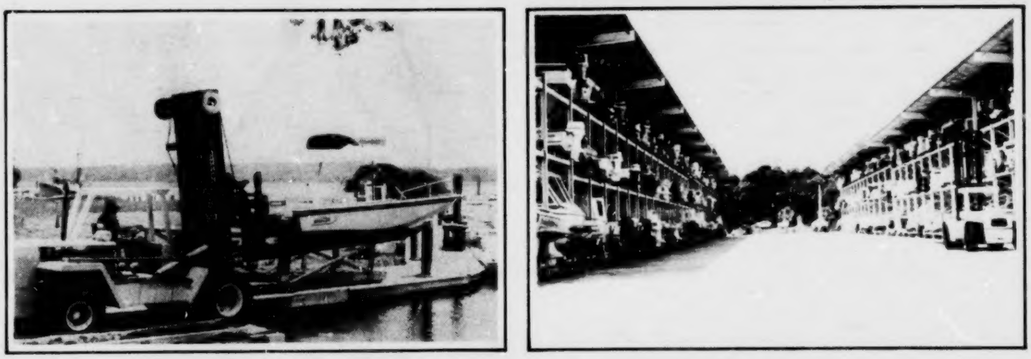
- Proper planning that complements the marina design can help avoid or minimize many of the impacts from marina development.
- Designs making maximum use of natural site attributes can significantly reduce or eliminate adverse construction impacts.
- Use of clear and concise marina operation and maintenance plans can contribute significantly to the environmentally sound performance of the marina facility.



Porous surface for runoff control

Controlling pollutants from runoff and boat wastes is a critical environmental solution. Measures that have or can be used include:

- Basin designs that promote flushing
- Effective spill, runoff and erosion control measures
- Mandatory pumpout facilities and slipside wastewater collection systems for sanitary wastes
- Use of upland facilities for boat maintenance activities
- Use of public or permanently dedicated upland sites for disposal of dredged material.



Upland boat maintenance and storage facilities

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[5] Fisheries and Marine Services. 1978. Guidelines for land development and protection of the aquatic environment. Tech. Rpt. No. 807. Fisheries and Oceans Canada, Vancouver, B.C. 55 pp.

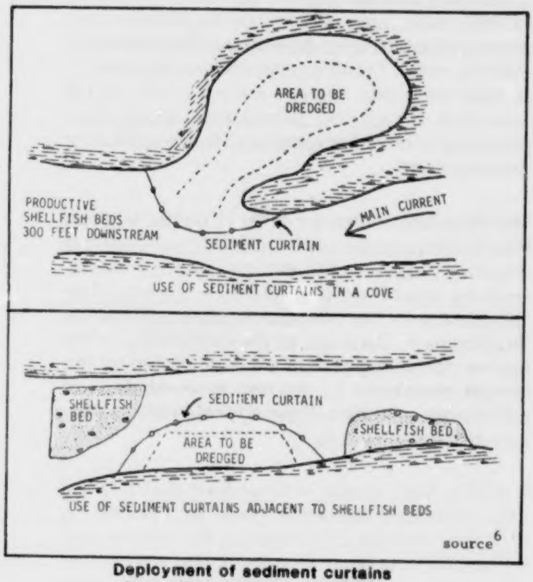
PROBLEMS

In addition to the pollutant control measures, ecological solutions for protecting aquatic habitats, shellfish and wetlands include:

- Use of sediment curtains during dredging
- Minimizing habitat modifications
- Scheduling construction activities around critical spawning or breeding periods
- Informing marina users of the presence of sensitive habitats and organisms and the need to avoid these sensitive areas
- Using sloping vegetated revetments and floating or detached breakwaters
- Extending dockage to deep water areas and providing upland boat storage
- Planting mangroves, marsh grasses or seagrasses to compensate for unavoidable habitat losses.

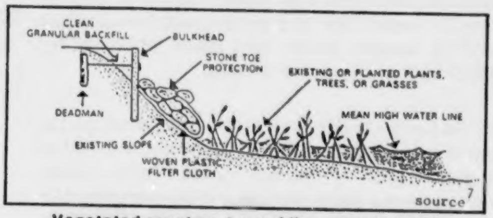
Many coastal states impose buffer zones around marinas, and shellfish beds are closed to harvesting in these areas. The Handbook provides a detailed discussion of marina permitting, shellfish resources and interpretation of the antidegradation policy as it applies to permitting marinas in open shellfishing waters because of the potential for resource-use conflicts between shellfishermen and marina developers.

Other alternative environmental solutions involve public access and aesthetic resources. Marina designs that incorporate provisions for public access to navigable waters by providing boat ramps, parks or other public recreational facilities are considered to be positive factors during permit application review. Marinas that are attractively designed and well-maintained can enhance the coastal area in which they are located.


AREA TO BE DREDGED
PRODUCTIVE SHELLFISH BEDS 300 FEET DOWNSTREAM
MAIN CURRENT
SEDIMENT CURTAIN
USE OF SEDIMENT CURTAINS IN A COVE
SHELLFISH BED
SEDIMENT CURTAIN
AREA TO BE DREDGED
SHELLFISH BED
USE OF SEDIMENT CURTAINS ADJACENT TO SHELLFISH BEDS

source[6]

Deployment of sediment curtains to protect sensitive organisms


CLEAN GRANULAR BACKFILL
BULKHEAD
STONE TOE PROTECTION
EXISTING OR PLANTED PLANTS, TREES, OR GRASSES
DEADMAN
MEAN HIGH WATER LINE
EXISTING SLOPE
WOVEN PLASTIC FILTER CLOTH

source[7]

Vegetated revetment providing aquatic habitat

Designing the marina for maximum use of natural site attributes, using good operation and maintenance practices, and selecting appropriate alternative environmental solutions can facilitate the entire marina development process from permit application through completion of marina development.

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[6] Virginia Marine Resources Commission. 1979. Best management practices handbook. Planning Bull. 319. VSWCB. Richmond, VA.

[7] U.S. Army Corps of Engineers. Alternatives to vertical bulkheads for shoreline protection. Brochure prepared by Jacksonville, District USACOE.

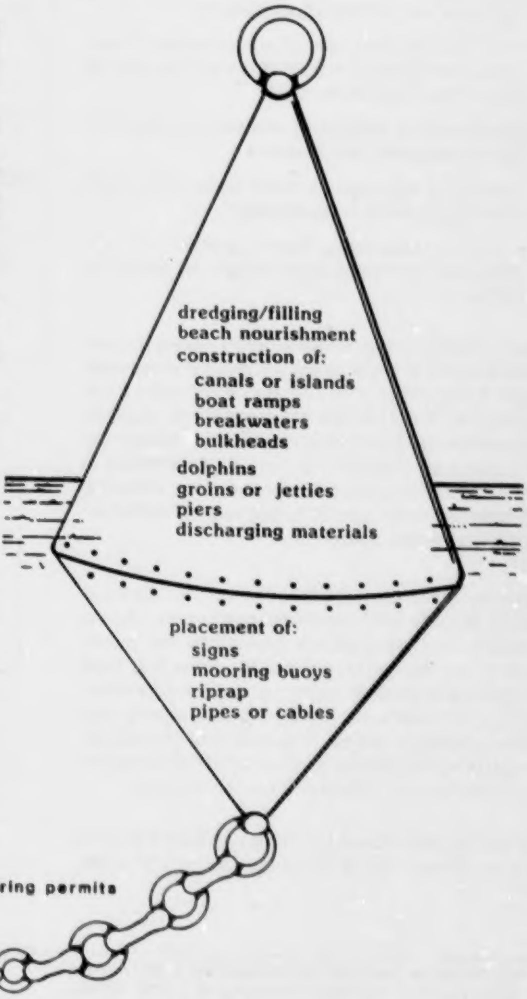
REGULATION IN MARINA DEVELOPMENT

A complex and sometimes confusing variety of federal, state, regional and local regulations concerning coastal marina development have evolved over the years. These regulations are designed to protect the public interest and conserve coastal resources by reducing development impacts and providing for an orderly approach to coastal marina development.

The Regulatory chapter in the Coastal Marinas Handbook provides both marina developers and regulatory agency staff with a resource that outlines the objectives, procedures and areas of responsibility for the principal regulators of marina development. Because of the complexity of the marina permitting process, it is advisable for the marina developer to request a pre-application conference with permitting agencies after selection of the marina site.

The U.S. Army Corps of Engineers (COE) is the primary federal agency involved with permitting of coastal marinas. EPA develops the criteria used by the COE and also has authority to veto Section 404 (dredge and fill) permits. The National Marine Fisheries Service and the U.S. Fish and Wildlife Service have significant review roles but do not issue permits. The U.S. Coast Guard is responsible for inspection of marine sanitation devices (MSD's) aboard boats and gives approval for placement of navigational aids.

Marina permit and review at the state level can be complex, involving multiple agencies, and varies among Region IV coastal states. Some states issue separate state dredge and fill, marshland or wetland permits for marina developments, while other states review federal permit applications but do not issue separate state permits. With the exception of Georgia, all coastal states have veto power over federal permits if the proposed action is inconsistent with the state's Coastal Zone Management program. All states issue water quality certifications under authority of the Clean Water Act.


dredging/filling
beach nourishment
construction of:
canals or islands
boat ramps
breakwaters
bulkheads
dolphins
groins or jetties
piers
discharging materials
placement of:
signs
mooring buoys
riprap
pipes or cables

Some activities requiring permits

S-15

The Clean Water Act requires states to adopt water quality standards that define state water quality goals for water bodies by indicating uses for the water body and setting criteria to protect that use. The water quality standards program, through the antidegradation policy, requires that existing uses be maintained. Shellfish harvesting is a use covered by the antidegradation regulations. The Handbook discusses the state's role in considering the antidegradation policy as it applies to state decision-making related to marina development in shellfishing waters.

Regional and local agencies require various permits and compliance with ordinances. Increasing participation of regional and local agencies in marina development has been observed in California and Florida. Some county regulations require liveaboard boats in marinas to be connected to a slipside sanitary wastewater system that delivers wastes to the municipal sewer system.

Innovative approaches are in place or are under development within Region IV to simplify the marina permitting process.

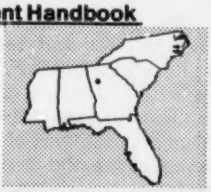
- Joint state/federal permits and granting states authority under Army Corps of Engineer general permits have been used to better coordinate among state and federal agencies.
- Clear and objective permit criteria made available to the marina developer and explained at the pre-application conference expedite the permitting process.
- A "Cooperative Outreach Program" can further streamline permitting processes by assigning a state field representative to assist the marina developer through the permitting process.

	RESOURCE							
AGENCY	Water Quality	Groundwater	Aquatic Habitat	Terrestrial Habitat	Wetland	Socio-Economic	Navigation	Aesthetic
U.S. Environmental Protection Agency	●	●			●			
U.S. Army Corps of Engineers	●	●	●		●	●	●	
U.S. Coast Guard	●						●	
North Carolina Department of Natural Resources and Community Development, Office of Coastal Management		●	●	●	●			●
North Carolina Division of Environmental Management	●	●						
South Carolina Coastal Council			●	●	●	●		
South Carolina Department of Health and Environmental Control	●	●						
Georgia Department of Natural Resources, Coastal Resources Division, Coastal Marshlands Protection Committee			●		●			
Georgia Department of Natural Resources, Environmental Protection Division	●	●						
Georgia Department of Natural Resources						●		
Florida Department of Environmental Regulation	●	●	●		●			
Florida Department of Community Affairs						●		
Florida Department of Natural Resources						●		
Alabama Department of Environmental Management	●	●	●		●			
Alabama Department of Conservation and Natural Resources			●			●		
Alabama State Docks Department							●	
Mississippi Bureau of Marine Resources			●	●	●	●		
Mississippi Bureau of Pollution Control	●	●						
Mississippi Secretary of State						●		

Major impact considerations by agency and resource

VHO TO CONTACT

For more information about the **Coastal Marinas Assessment Handbook** contact **EPA Region IV:**



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The agencies listed below may be contacted for specific information about marina development in Region IV coastal states:

NORTH CAROLINA

Wilmington District
Corps of Engineers
P.O. Box 1890
Wilmington, NC 28402
Telephone: (919) 343-4631

Department of Natural Resources
and Community Development
Office of Coastal Management
P.O. Box 27687
Raleigh, NC 27611-7687
Telephone: (919) 733-2293

SOUTH CAROLINA

Charleston District
Corps of Engineers
P.O. Box 919
Charleston, SC 29402
Telephone: (803) 724-4330

Coastal Council
Office of Coastal Planning
Summerall Center, Suite 802
19 Hagood Avenue
Charleston, SC 29402
Telephone: (803) 792-5808

GEORGIA

Savannah District
Corps of Engineers
P.O. Box 889
Savannah, GA 31402
Telephone: (912) 944-5347

Department of Natural Resources
Coastal Protection Division
Marsh and Beach Section
1200 Glynn Avenue
Brunswick, GA 31523
Telephone: (912) 264-7365

FLORIDA

Jacksonville District
Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232
Telephone: (904) 792-1666

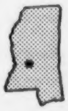
Department of Environmental Regulation
Twin Towers Office Building
Tallahassee, FL 32301-8241
Telephone: (904) 488-0130

ALABAMA

Mobile District
Corps of Engineers
Regulatory Functions Branch
P.O. Box 2288
Mobile, AL 36628
Telephone: (205) 694-3771

Department of Environmental Regulation
Permit Coordination Center
1751 Federal Drive
Montgomery, AL 36130
Telephone: (205) 271-7700

MISSISSIPPI



Mobile District
Corps of Engineers
Regulatory Functions Branch
P.O. Box 2288
Mobile, AL 36628
Telephone: (205) 694-3771

Department of Natural Resources
Bureau of Pollution Control
Jackson, MS 39209
Telephone: (601) 864-4602

1.0 INTRODUCTION

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1.0 INTRODUCTION

1.1 Background

In 1983, the USEPA Region IV Environmental Assessment Branch initiated an environmental assessment of the development and operation of coastal marinas. The study responded to existing resource-use conflicts between shellfishermen and marina developers in Region IV coastal states and addressed the growing regulatory concerns for balancing the development and operation of coastal marinas with the need to conserve and protect coastal resources. The objective of the assessment was to: identify pertinent environmental concerns and issues, and to provide guidance for environmentally sound coastal marina development and operation.

Initial Concerns and Key Factors

Concerns and issues were identified through site visits and discussions with regulatory agencies, marina developers and operators, shellfishermen and other interested parties. Background information in the environmental, engineering and institutional areas pertinent to coastal marinas was provided in the Inventory of Existing Conditions and Key Factors Task Report. Two project committees were formed to serve as a resource and to guide project development through review and comment on documents. This report identified the principal concerns for marina-related problem areas and the key factors for which guidance was developed (Table 1-1). These concerns were:

- Projecting Environmental Impacts
- Direct Habitat Alteration
- Natural Resource Impacts
- Water Quality Impacts
- Socioeconomic Impacts
- Effectiveness of Decision-Making Processes
- Compliance with Standards and Regulations.

Guidance Development

The overall objective of guidance development was to provide specific users with succinct information for use in dealing with marina-related problems. The key factors identified from the Inventory were evaluated to select those of particular relevance for guidance development. The selection was based on the relative importance of concerns and/or issues of recognized importance. The number of key factors was restricted to prevent dilution of effort. This process resulted in six key factors: impact assessment techniques, siting, shellfish buffer zones, pollutant control, permit process and monitoring and compliance. These key factors were finalized into four key factors for guidance development:

- Siting
- Impact assessment techniques

1

TABLE 1-1

MAJOR CONCERNS AND INITIAL KEY FACTORS PERTINENT TO COASTAL MARINAS

Concerns	Impact assessment	Siting	Marina Design	Regulation and public education	Pollutant control	Monitoring and compliance	Regional planning	Permit process	Performance standards and specifications
Impact projections	X								
Direct habitat alteration		X	X						
Natural resource impacts		X	X	X					
Water quality impacts		X	X	X	X				
Socioeconomic impacts		X					X		
Effectiveness of decision-making processes	X							X	
Compliance with standards and regulations						X			X

- Impact mitigation
- Regulatory/planning processes.

Shellfish resource issues, including buffer zones, were addressed under the siting and regulatory/ planning processes key factors. Pollutant control was addressed under impact mitigation. Permit process and monitoring and compliance were addressed under regulatory/planning processes.

The first task in developing guidance was to identify major impact categories, specific impacts and sources of these impacts to serve as a checklist for guidance development (Figure 1-1). These major impact categories and sources of impacts provided the basis for discussions in respective chapters of the Guidance Handbook Task Report.

1.2 Purpose and Use of the Handbook

The information and guidance presented in the Inventory and Guidance Handbook Task Reports were refined and combined to produce the Coastal Marinas Assessment Handbook. Although developed specifically for the EPA Region IV coastal states, much of the information in the Handbook is applicable nationwide.

The Handbook examines the major aspects of coastal marina development:

- Siting
- Environmental Impacts
- Environmental Solutions
- Regulation.

Handbook organization provides the user with a stepwise approach to environmentally sound marina development and regulation, from siting considerations through environmental solutions applicable during marina operation.

The Siting chapter is designed for the potential marina developer to serve as a site planning guide for use before initiating state and federal permit applications. A screening checklist for site planning is provided. This checklist is keyed to subsequent Environmental Impacts and Environmental Solutions chapters. Reference to and use of the screening checklist should assist the developer in obtaining an overview of the advantages or potential problem areas associated with proposed marina sites and facilitate optimum site selection. Topics discussed include:

- Marina development process
- Environmental and engineering considerations for site planning
- Advantages and disadvantages of potential marina sites
- Identification of potential permitting issues

ENVIRONMENTAL IMPACT CONSIDERATIONS

Impact Source Considerations	Water Quality										Ecological									Other						
	Turbidity	Dissolved Oxygen	Nutrients	Bacteriological	Metals	Hydrocarbons	Toxic Substances	Other Pollutants	Erosion	Hydrological	Endangered Species	Birds/Rookeries	Benthos	Shellfish	Other Aquatic Organisms	Grassbeds	Wetlands	Nursery Areas	Terrestrial Habitats	Aesthetics	Historical/Archaeological	Navigation	Marine Resources	Local Economy	Local Land Use	Public Access
Marina Location										S	S	S		S		S	S	S	S	S	S	S	S	S	S	S
Marina Size & Services																							S	S	S	S
Dredging	S	S	S		S	S	S	S		S	S		S	S	S	S	S	S								
Spoil Disposal	S	S			S	S					S	S	S	S	S	S	S	S	S	S						
Filling	S	S	S					S		S	S	S	S	S	S	S	S	S	S	S						
Grading & Clearing	C		C						C			C							C	C						
Hydrological Modification	D	D	D	D	D	D	D	D		D							D					D				
Structures									D	D				D			D	D	D			D				
Point Wastewater Discharge	D	D	D	D	D						D		D	D						D						
Non-point Source Runoff	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D						
Boat Operation	E								E		E			E		E	E	E		E						
Boat Discharges		E	E	E										E						E						
Spills						O						O	O	O	O			O		O						
Boat Maintenance			E			O	O	O						O												
Litter											E									E						
Noise												O								O						

Primary Environmental Solutions

S = Environmentally Sound Marina Site Selection
D = Design of Marina with Environmental Considerations
C = Environmentally Guided Marina Construction Techniques
O = Proper Operation and Maintenance of Marina Systems and Boats
E = Enforcement of Rules and Regulations and Education of Marina Users in the Environmental Impacts or Their Actions

Figure 1-1. Environmental impacts, sources and primary solutions.

The Environmental Impacts chapter presents predictive assessment techniques for potential problem areas identified through use of the screening checklist. The chapter is designed for use by developers and regulatory agencies in evaluating problem areas pertinent to marina development. Assessment techniques are provided for water quality, ecological and other impacts. Methods are presented for estimating:

- flushing time
- sediment deposition and shoaling
- pollutant concentrations
- waste contribution from boats

Guidance is given on how to consider these impacts.

The Environmental Solutions chapter presents optional mitigative measures that the engineer or planner may use or regulatory agency may recommend to reduce or eliminate specific impacts from marina construction and operation. Mitigative measures for water quality, ecological, and other impacts are presented for marina design and construction activities and for operation and maintenance activities.

The Regulation chapter describes the authority and responsibilities of pertinent regulatory/planning agencies concerned with the various major impact categories. A matrix is provided to concisely identify those agencies that are concerned with specific coastal resources and their main functional roles. Desirable features of regulatory/planning processes are described and their use within USEPA Region IV is discussed. Permit evaluation criteria are summarized for federal and state regulatory agencies.

The Handbook also provides a detailed bibliography and appendices containing sample permit application forms, examples of measurement methods for marina environmental assessment and example of ordinances that regulate coastal marina activities.

2.0 MARINAS IN THE COASTAL ZONE

2.1 Marina Benefits 2-1

2.2 Marina Demand 2-1

2.0 MARINAS IN THE COASTAL ZONE

The six coastal states in USEPA Region IV provide almost 18,000 miles of shoreline that invite exploration by recreational boaters (Figure 2-1; NEAI, 1985). Presently there are approximately 930 coastal marinas in Region IV.

A survey of marina and facility listings in the Mid-Atlantic and Southern Waterway Guides (Taylor, 1983) revealed 587 coastal marinas operating along the Intracoastal Waterway within the six Region IV coastal states (Table 2-1). The greatest concentration of marinas occurs in Florida and North Carolina, which account for 90 percent of the marinas listed (Figure 2-1). Most of the marinas are open year-round and serve both sail and power boats. These marinas offer the opportunity for overnight docking or permanent liveaboards. Services offered include engine, propeller and hull repair, fuel, electricity, sanitary services and food. Both gasoline and diesel fuel are available at 63 percent of these marinas and 50 percent of the marinas offer engine repair services. Approximately 50 percent of the marinas also provide either propeller or hull repairs. Pumpout stations for sanitary wastes are available at approximately 13 percent of these marinas. However, the guide notes that some pumpout stations may not be operable because of infrequent use.

2.1 Marina Benefits

In addition to providing protected areas for mooring boats, marinas provide many social and economic benefits within the coastal zone. Launching ramps provide points of access to coastal waters for recreational boaters. Marinas also may serve as focal points for community activities by providing picnic areas, children's playgrounds or swimming pools. Attractive marinas are aesthetically pleasing and may serve as a focus for planned development of restaurants, shops and residences.

Marinas provide direct and secondary economic benefits. Local communities may benefit through tax revenues. The marina owner and the broader marina industry benefit through sales of boats, marine engines, marine electronics and accessories, and through servicing these items and supplying raw materials for their manufacture. Gift shops, restaurants and motels provide revenue and employment opportunities. Marina operation also may benefit marine insurance companies and financial institutions that finance facilities and equipment.

From the perspective of environmental management, marinas concentrate boating activities, allowing for more effective management than could be attained with numerous private docks. However, some potentially adverse environmental effects also are associated with marina construction and operation and with boating activities. These effects may be exacerbated through improper marina siting, design or management.

2.2 Marina Demand

The spread of diverse developments within the coastal zone has intensified the management concerns of agencies responsible for protecting coastal environmental resources. Although the policy to protect natural resources is in the public interest, there is increasing need for a

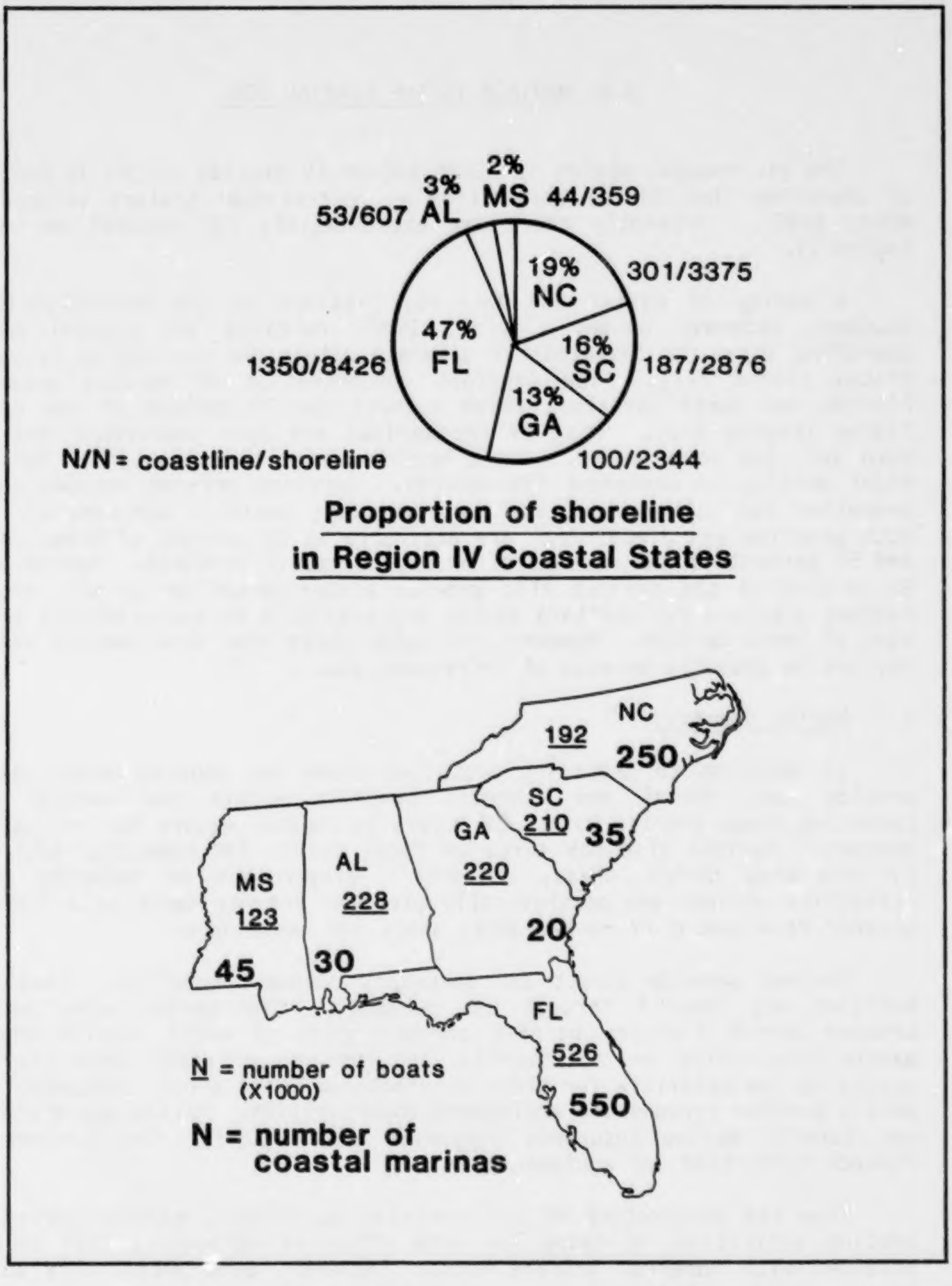

Figure 2-1. Proportion of shoreline, approximate number of coastal marinas and registered boats in Region IV coastal states.

TABLE 2-1

MARINA[a] FACILITIES AND SERVICES WITHIN USEPA REGION IV[b]

	Number of Marinas Offering Services					
Type of Service	North Carolina	South Carolina	Georgia	Florida	Alabama	Mississippi
Open: year round	108	31	10	417	9	6
seasonal	6	0	0	0	0	0
Facility:						
sail	2	0	1	4	1	0
power	14	2	0	34	1	0
both	101	31	9	376	8	11
No. of transient berths[c]	1,090	356	138	4,141	53	50
Fuel: gas	14	1	1	86	0	1
diesel	0	3	0	4	0	0
both	68	27	8	251	9	7
Handling method:						
railway	17	6	3	59	1	2
lift	22	7	4	164	2	6
travelift	21	6	2	108	2	7
ramp	47	11	1	150	4	4
Engine repairs:						
gas	12	0	1	66	0	2
diesel	0	0	1	4	0	0
both	46	27	5	201	8	9
Repairs:						
propeller	40	19	6	231	6	6
hull	47	15	6	206	7	8
Electricity available	110	33	9	419	11	11
Sanitary needs:						
shower	64	27	9	263	5	6
laundry	25	17	6	148	4	5
pump-out station[d]	5	7	1	57	2	3
Food: restaurant	37	14	3	178	7	7
snack bar	42	10	4	143	6	4

---

[a] A marina is defined as being able and willing to accept cruising boats of a minimum of 25 feet and have at least minimal facilities.

[b] Taylor, 1983

[c] Number of slips available for transient use.

[d] Pump-out stations may not be operable since some are used infrequently.

balanced management approach. Increasing population and increased demand for recreational use of coastal waters is evident in the USEPA Region IV coastal states. In North Carolina, for example, population density in coastal counties increased by 18 percent, while the number of registered boats increased by 86 percent between 1973 and 1983. Demand for marinas, which provide the access to coastal waters, also has increased. From 1980 to 1985 the number of coastal marinas in South Carolina increased from 12 to 35, with 24 permits pending approval. In Florida, demand for coastal berthing facilities is projected to increase by 63 percent between 1982 and 2005 (Bell and Leeworthy, 1984). It is important that agencies responsible for marina development disseminate information and provide positive developmental guidelines. This will lead to more effective resource management and help developers avoid excessive costs from pursuing unacceptable options. The challenge is to meet this demand through prudent application of environmentally sound principles in the siting, design, construction and operation of coastal marinas.

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3.0 SITING

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3.0 SITING

3.1 Overview

Proper siting of a coastal marina is probably the single most important aspect of developing the marina in an environmentally sound manner. A well chosen marina location that meets the developer's needs and at the same time minimizes environmental impacts should be the most cost-effective to develop and will likely receive the quickest approval by regulators.

This chapter provides information and guidance on coastal marina site evaluation and selection. The discussion is an overview of the advantages and problem areas associated with certain marina sites and an introduction to topics of marina development impacts discussed in more detail in later chapters.

Section 3.2 presents a discussion of general site locations for coastal marinas and environmental impact considerations related to marina locations. The marina development process is summarized in Section 3.3. Central to this chapter is presentation of the Coastal Marinas Screening Checklist in Section 3.4. The checklist was designed for use in site description and planning and can be used to identify areas of environmental concern that could result in permitting problems. An item by item discussion of the Screening Checklist provides information and guidance in using the checklist for site evaluation. The checklist also is useful for identifying areas where additional information on a marina project may be needed.

The Coastal Marinas Screening Checklist is keyed to subsequent sections of the Handbook that describe the environmental impacts of marina development, impact assessment techniques and environmental solutions to potential impact problems. This chapter concludes with a summary of the desirable and undesirable features of certain marina sites.

3.2 Marina Location

3.2.1 General Site Locations

Small craft harbors are usually located in estuaries, bays, inlets or coves. Open shorelines are also used. Marinas also have been constructed in intertidal lowlands and salt marshes. Due to recent environmental interest in preserving wetland areas, development in wetlands has diminished. The engineer should consider sites with maximum natural protection that minimize alterations to the natural topography.

Estuaries

River mouths or estuaries have certain advantages as a marina site. The area on either side of the estuaries is usually protected from ocean waves and the effect of river currents is minimized. The river has usually scoured a channel for navigation. Tides, when present, improve circulation in the marina basin. Freshwater river flow also decreases the activity of fouling organisms. The site, however, may be subject to occasional flooding and sedimentation.

Riverside Sites

Tidal rivers provide excellent water courses for small cruising craft. Marinas are often located along or just beyond a river bank. Protection from floating debris and fluctuations in the water level may be required. In some instances canals and basins may have to be excavated into uplands behind the river bank.

Embayments

Natural embayments, coves, and inlets are considered excellent marina sites, provided the entrance to open water is sufficiently small or protected by islands to minimize the effects of wave action and sensitive environmental resources are not adversely affected. The embayment should also be small enough so that undesirably large wind-generated waves are not produced within the bay.

Lowlands Areas

Lowland areas adjacent to ocean and lake areas also are used as marina sites. Because they are low, marshes and intertidal lands serve as natural barriers against storm floods and hurricanes. The vegetation cover and low gradient act to dissipate wave energy and serve as receptacles for surplus storm-tide waters. Alternative marina construction techniques and effective use of dredge spoil can create a marina that is compatible with the marsh environment (Giannia and Wang, 1974).

Open Shorelines

Open shorelines areas can be suitable for marinas if breakwaters or artificial harbors are constructed to protect against wave action. These facilities require a more detailed design and can be more costly to construct than those in more natually protected locations.

3.2.2 Environmental Impact Considerations

Major environmental considerations in the siting and design of marinas are loss of habitat from dredging and construction of shoreline structures, the effects of stormwater runoff and discharge from boats on water quality and the effect on coastal aesthetic values. Marinas are designed to provide safe, protected moorings for boats and so are usually located in calm waters on protected shorelines. These calm, sheltered areas generally support wetlands and submerged seagrass beds. Thus, the potential for habitat loss or alteration of these productive habitats is a major consideration in marina siting and design, unless the marina is excavated from an upland area.

Coastal Ecology

Loss of wetland and submerged vegetation may result from a variety of construction activities, although dredge and fill operations have historically been the most destructive. The amount of habitat lost through marina development has been relatively low when compared with losses to coastal housing and industrial developments, causeway construction and navigational dredging. Although most individual marina projects result in relatively small total impacts on the coastal ecosystem, the cumulative effect of many marinas together with other coastal development has eliminated vast areas of coastal wetland vegetation.

The importance of plant communities such as mangroves, salt marsh grasses and seagrass beds lies in the vital functions that they perform in the aquatic ecosystem. First and foremost is their role in converting sunlight and nutrients into food usable by animals, thus forming the base of the aquatic food chain. Odum (1971) estimated that the richest coastal marshes produce 3.7 metric tons per hectare (10 tons per acre) of plant material per year, or more than six times the average amount of wheat produced per acre. Relatively little of this plant material is eaten directly by higher animals. Instead, it is broken down into detritus by microorganisms and consumed by small crustaceans and other animals which are, in turn, eaten by large animals and so on up the food chain.

In addition to serving as a food source, wetland and submerged vegetation provide shelter and nursery areas for the young of many economically important species such as shrimp, seatrout, mullet and red drum. Although many species do not spend their entire lives within the estuaries, it is estimated that nearly 70 percent of the most valuable Atlantic coast fish species are directly dependent on the estuaries during some stage of life (Clark, 1967).

Another important function of vegetation is to trap silt and absorb pollutants and excess nutrients resulting from surface runoff. In this way vegetation buffers the coastal ecosystem from upland sources of pollutants (Maloney et al., 1980b). Vegetation also protects upland areas by stabilizing coastal sediments and preventing erosion. Finally, natural vegetation increases the aesthetic appeal of the coastal zone.

Oyster beds are another habitat requiring consideration during marina siting and development. In addition to their direct economic value to man, oyster beds or reefs provide spawning and nursery areas, substrates for attachment for many organisms, and food for invertebrates, fish and mammals. Oyster reefs physically influence the marsh-estuarine ecosystem by modifying current velocities, changing sedimentation patterns and actively augmenting sedimentation through biodeposition (Bahr and Lanier, 1981).

Oyster beds could be affected by physical disruption of habitat during marina construction or by changes in water quality resulting from marina operation or boating activities. A poorly sited or designed marina has the potential to degrade water quality so that oysters are unfit for human consumption. Other inhabitants of the aquatic environment also may be affected by changes in water quality, which at times include nutrient enrichment and low dissolved oxygen resulting from sewage and upland runoff, hydrocarbons from boat exhausts and fuel spills, heavy metals from antifouling paints and other pollutants.

Aesthetics

Marina location also influences the effect a marina will have on shoreline aesthetic value because introduced sights, sounds and smells will be different from the natural environment (Chmura and Ross, 1978). Poorly maintained marinas will further degrade aesthetic values (Rose, 1976). Aesthetic values are subjective and difficult to measure. Marinas located in a pristine area may lessen aesthetic appeal, whereas marinas located in a developed area may enhance the aesthetic appeal and quality of the water front (Chmura and Ross, 1978).

3.3 Marina Development Process

A comprehensive marina development process involves five steps: 1) analyzing the market; 2) developing a market strategy; 3) identifying the marina site; 4) performing feasibility analyses and preliminary design and 5) performing final design and developing the marina (Figure 3-1). These five steps occur in two phases, an initial broad screening evaluation and a detailed site-specific evaluation.

The initial broad screening evaluation is used to identify those sites that warrant a more detailed evaluation and to eliminate those sites that are unacceptable for further consideration. Unacceptable sites may be those located in areas where sufficient demand cannot be demonstrated or where access is unacceptable. Analyzing the market is often the first step taken by a developer in the initial broad screening evaluation. Need and demand for the marina and types of services to be provided are investigated through user surveys and evaluations of existing marinas, boat sales and recreational water use. The market analysis is usually followed by formulation of a market strategy and refinement of the original marina concept, including type of services to be offered and number, size and type of boats to be accommodated. The crucial third step in the marina development process, completing the initial broad screening evaluation, involves identification of the most acceptable marina site.

Some marina developments follow a somewhat different process in the initial phase. In these cases marinas are developed in conjunction with a larger project. The larger project will generate the market and thus determine the market strategy. In these cases the determination of the marina site is highly dependent on other aspects of the overall project.

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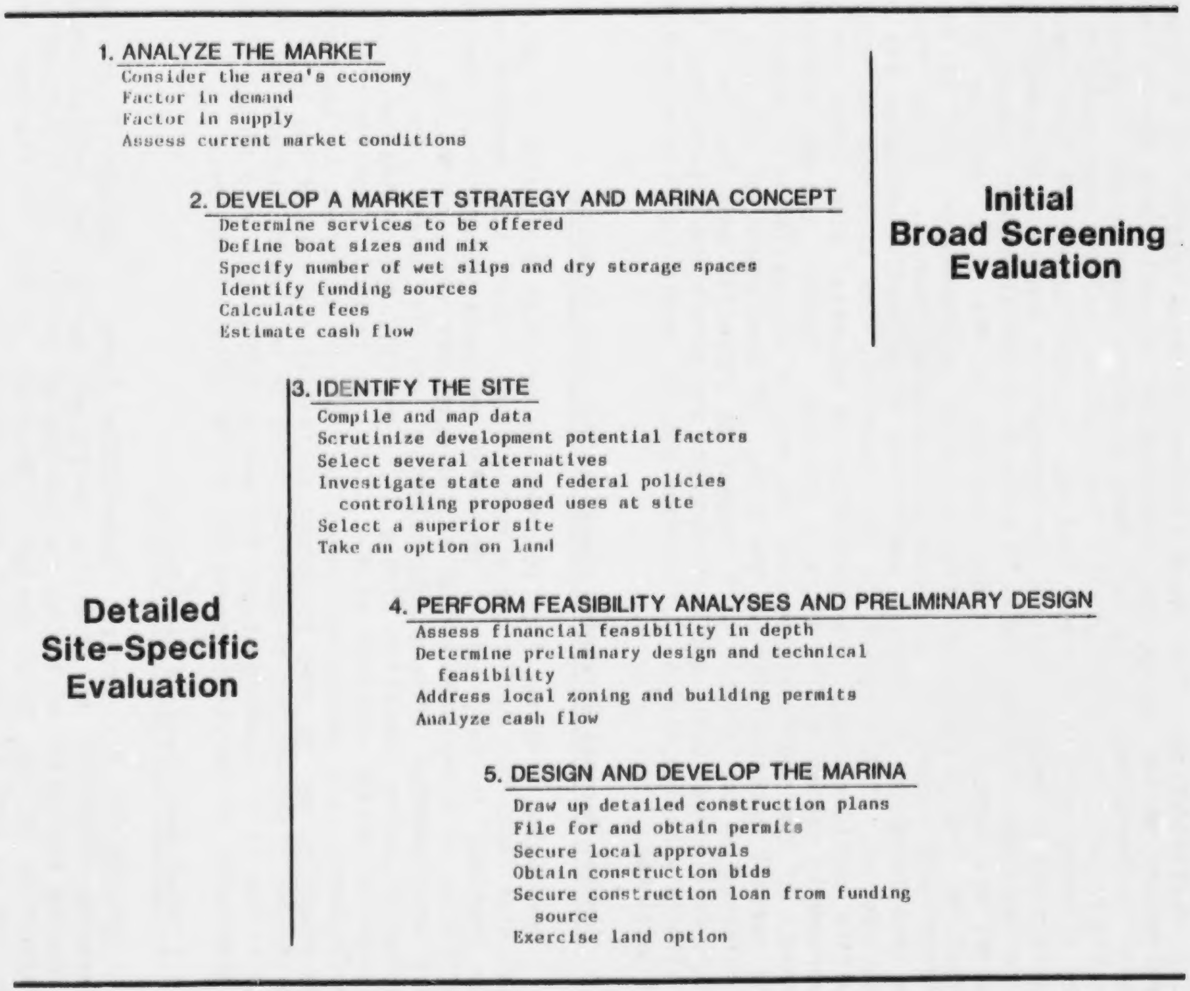

1. ANALYZE THE MARKET
- Consider the area's economy
- Factor in demand
- Factor in supply
- Assess current market conditions

2. DEVELOP A MARKET STRATEGY AND MARINA CONCEPT
- Determine services to be offered
- Define boat sizes and mix
- Specify number of wet slips and dry storage spaces
- Identify funding sources
- Calculate fees
- Estimate cash flow

3. IDENTIFY THE SITE
- Compile and map data
- Scrutinize development potential factors
- Select several alternatives
- Investigate state and federal policies controlling proposed uses at site
- Select a superior site
- Take an option on land

4. PERFORM FEASIBILITY ANALYSES AND PRELIMINARY DESIGN
- Assess financial feasibility in depth
- Determine preliminary design and technical feasibility
- Address local zoning and building permits
- Analyze cash flow

5. DESIGN AND DEVELOP THE MARINA
- Draw up detailed construction plans
- File for and obtain permits
- Secure local approvals
- Obtain construction bids
- Secure construction loan from funding source
- Exercise land option

Figure 3-1. Marina development process (Adapted from Rogers, Golden and Halpern, 1982).

Because this chapter is designed to provide assistance in identifying environmentally sound marina sites and in developing the marina facility in an environmentally sound manner, the rest of this chapter focuses on the last three steps of the marina development process. The detailed site-specific evaluation is undertaken following the initial site identification. This phase involves in-depth feasibility analyses, preliminary marina design and consideration of applicable regulations. Major considerations during this phase of marina planning are illustrated in Figure 3-2. The detailed site investigation includes consideration of the existing natural features that may be used for marina development. Maximum use of natural features can decrease the amount of site modification required. This will help to minimize potential impacts and possibly lessen development costs. Modifications to the site, such as those resulting from dredging or construction of a breakwater, must be considered with respect to potential environmental impacts. If the impact is considered to be adverse, evaluation of mitigative measures may be required or, if mitigation is not practical, the site may no longer justify consideration. The limitations of potential sites often can be overcome by making modifications to the site. However, the environmental impacts of the modifications and the cost of mitigation will determine the overall acceptability of the site. If development of the site is considered to be feasible with respect to potential need for the facility, development costs and environmental and permitting issues, then the preliminary marina design is finalized and the permit application process is initiated.

3.4 Coastal Marinas Screening Checklist for Site Planning

Developing a marina facility requires detailed evaluation of potential site locations during the planning stage. Every site presents unique problems in relation to providing adequate recreational boating facilities at a reasonable cost to the developer while minimizing negative environmental effects and promoting positive ones. The Coastal Marina Screening Checklist (Table 3-1) provides the marina developer, planner or design engineer with a means for initial identification of environmental and permitting issues that may be pertinent to the site. The checklist may be used to obtain an initial overview of the relative merits and disadvantages of multiple sites or to provide information for use in the early planning stages for marina development at a single site. A discussion of the elements and use of the checklist follows.

3.4.1 Part One - Project Description

Information for Project Description Items 1 through 7 of the Screening Checklist is generally developed during the initial broad screening evaluation of the marina development process and is refined in preparation of the final design. Detailed project descriptions are required as part of the marina permit application. Examples of information requirements by individual states may be found in the permit application materials in Appendix G. These materials are provided as examples only. The developer should contact appropriate federal and

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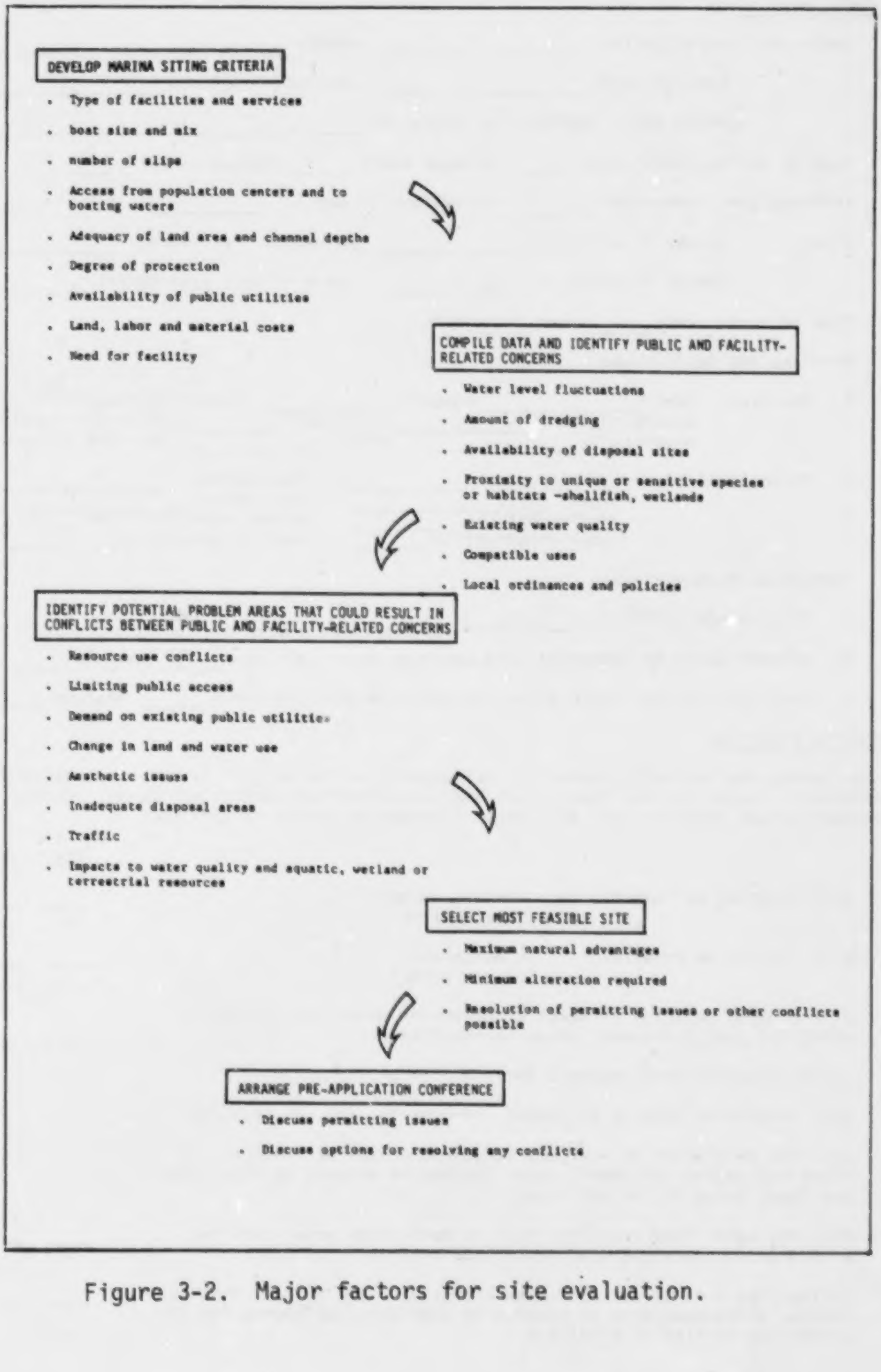

DEVELOP MARINA SITING CRITERIA

- Type of facilities and services
- boat size and mix
- number of slips
- Access from population centers and to boating waters
- Adequacy of land area and channel depths
- Degree of protection
- Availability of public utilities
- Land, labor and material costs
- Need for facility

COMPILE DATA AND IDENTIFY PUBLIC AND FACILITY-RELATED CONCERNS

- Water level fluctuations
- Amount of dredging
- Availability of disposal sites
- Proximity to unique or sensitive species or habitats -shellfish, wetlands
- Existing water quality
- Compatible uses
- Local ordinances and policies

IDENTIFY POTENTIAL PROBLEM AREAS THAT COULD RESULT IN CONFLICTS BETWEEN PUBLIC AND FACILITY-RELATED CONCERNS

- Resource use conflicts
- Limiting public access
- Demand on existing public utilities
- Change in land and water use
- Aesthetic issues
- Inadequate disposal areas
- Traffic
- Impacts to water quality and aquatic, wetland or terrestrial resources

SELECT MOST FEASIBLE SITE

- Maximum natural advantages
- Minimum alteration required
- Resolution of permitting issues or other conflicts possible

ARRANGE PRE-APPLICATION CONFERENCE

- Discuss permitting issues
- Discuss options for resolving any conflicts

Figure 3-2. Major factors for site evaluation.

TABLE 3-1

COASTAL MARINA SCREENING CHECKLIST

Project Description

1. Location: municipality ____________ county ____________

body of water ____________ latitude/longitude ____________

state water quality classification ____________

2. Type of marina: open water _____ dredged basin _____ locked harbor _____

3. Intended use: commercial _____ recreational: public _________ private _________

4. Size: upland area (ha/ac) _________ submerged area (ha/ac) _________

number of slips _________ range in slip size (m/ft) _________

5. Type of boat: sail ____ power _____ both _____

6. Services and facilities:

A. Services: fuel ________ pumpout ________ launching ramp/hoist ________

engine repair ________ hull repair ________ propeller repair ________

electricity ________ water ________ dry dock storage ________

B. Other Facilities: ship's store ________ residential development ________

hotel ________ access road/utilities ________

restaurant ________ seafood processing ________

boat construction ________

7. Hydrographic conditions:

A. Tidal Range (m/ft): ____________________

B. Natural depth of waters at site (m/ft at MLW): minimum _____ maximum _____

C. Completed project depth at marina (m/ft at MLW): minimum _____ maximum _____

Screening Checklist

In completing the following checklist, all aspects of the project as addressed above should be considered. Checks in the "Yes" column indicate potential permitting issues. Checks in the "Unknown" column indicate that additional information should be obtained.

	Yes	No	Unknown
1. Will dredging be required for: access channel?	___	___	_____
boat basin?	___	___	_____
2. Will filling be required: on wetlands?	___	___	_____
in open water?	___	___	_____
3. Will dredged material disposal at locations other than currently permitted public disposal areas be required?	___	___	_____
Is the disposal area adequate for the life of the project?	___	___	_____
4. Will structures such as bulkheads, revetments, etc. be required?	___	___	_____
5. Will the water body at the site be characterized by low flushing rates (dead-end channel or canal, upper reaches of estuary or tidal creek, low tidal range or low net flow)?	___	___	_____
6. Does the water body presently fail to meet state water quality standards for existing use classifications?	___	___	_____
7. Is the site located within 1.6 km (1 mi) of a designated wildlife refuge, wilderness area or other area specially designated for the protection of fish or wildlife?	___	___	_____

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Screening Checklist
(continued)

		Yes	No	Unknown
8.	Are any rare, threatened, endangered or otherwise designated unique or outstanding aquatic or terrestrial species or their habitats known to be present at the site? (Contact state wildlife agency, US Fish and Wildlife Service and National Marine Fisheries Service).	___	___	______
9.	Do shellfish beds occur within 600 m or 2000 feet of the site or within 300 m or 1000 feet of access channels?	___	___	______
10.	Are grassbeds located within 300 m or 1000 feet of the marina or access channels?	___	___	______
11.	Is the site in an area of recognized historic, archaeological or scenic value? (Contact State Historic Preservation Officer).	___	___	______
12.	Are local residents or landowners opposed to the project or unaware of the project?	___	___	______
13.	Will any proposed activity be inconsistent with state coastal zone management plans or local management plans, ordinances or zoning requirements? (Contact state and local coastal zone management offices and local planning office).	___	___	______
14.	Will the project obstruct public land access to navigable waters?	___	___	______
15.	Will the project require structures which would extend into or otherwise obstruct existing channels or will the project require placing structures closer than 100 feet to a federally-maintained channel or basin?	___	___	______

state permitting agencies for the most current materials that may contain modifications or changes in information requirements. Unnecessary delays in the permit review process may be avoided by submitting a detailed and complete project description as part of the application.

Item 1 - Location

In selecting a marina site, two access requirements must be met regardless of the type of marina or where it is to be located. The site must provide safe navigational access to cruising waters and have adequate land access for boat owners to reach the marina (Dunham and Finn, 1974). Precise location of the site is important for identifying potential difficulties related to land, water or utility access or potential regulatory issues related to conflicts with state or local management plans, ordinances, zoning requirements or natural resource management policies. Proximity of the site to population centers, accessibility of the marina from the land side and easy access to desired water use areas are important evaluation factors. Many people are unwilling to drive longer than one to one and a half hours to get to a marina unless the drive also reduces the boating time necessary to gain open water access. The marina site should be located within safe and convenient use of a waterway. Winding channels, hazardous routes, and long travel distances to the water use area are generally considered unacceptable. Distance is even more important because most recreational boats will travel on the order of 16 kph (10 mph; C. Chamberlain, 1983). Ideally, the site should have two all-weather access roads suitable for automobiles, fire fighting equipment, trucks and boat trailering (Chaney, 1961). Site feasibility is severely limited without electrical or telephone service and fuel deliveries. Available water and sewer lines will decrease capital and maintenance costs and may shorten the time required to obtain permit approval. Certain general requirements based on the types of boats and boating activities appropriate to the marina concept also must be considered in selecting the marina location (Chamberlain, 1983; Figure 3-3). These considerations relate to the type of water body, water access needs and minimum channel depths required.

Item 2 - Type of Marina

The type of marina proposed directly relates to the potential for environmental impacts. Open marinas in well-flushed tidal creeks or estuaries may minimize the potential for water quality impacts that could result from the buildup of pollutants in poorly flushed dredged basins. Locked-harbor marinas dredged from upland areas also may lessen impacts to aquatic and wetland resources by limiting submerged area use requirements and modifications to aquatic and wetland habitats. Locked-harbor marinas also provide the option of protecting water quality in the event of a spill by isolating marina waters during cleanup procedures. The type of marina proposed may directly affect potential water quality or habitat resource permitting issues related to environmental protection. Methods for predicting flushing rates for open and semi-enclosed marinas are available in Section 4.2.1. Mitigative measures to facilitate

Boat Type and Activity	WATER BODY TYPE				WATER ACCESS NEEDS							MINIMUM CHANNEL DEPTH			SPECIAL ATTRIBUTES NEEDED	
	Canal	River	Bay	Coast	Open ocean or bay within 5 miles	Suitable fishing waters within 5 miles	Inlets, islands, beaches for safe anchorage within 20 miles	Inlets, islands, beaches for safe anchorage within 10 miles	Access to suitable open water within ½ mile	Pond or channel at least 1 mile wide	Pond or channel at least 5 miles wide	4 feet	6 feet	8 feet	Relatively protected waters	Few shoreline hazards
Commercial fishing and deep sea charter dock		●	●	●	●								●			
Long-distance powerboat cruising	●	●	●	●	●		●							●		
Long-distance sailing		●	●	●	●			●						●		
Estuarine fishing	●	●	●			●						●				
Local powerboat cruising	●	●	●	●	●		●						●		●	●
Day sailingⓢ and racingⓡ		●	●	●				●	●	ⓢ	ⓡ		●			●
Water-skiing and water sports		●	●	●					●	●		●			●	●

Figure 3-3. General requirements of marinas by boat type and boating activity. (Adapted from Rogers, Golden and Halpern, 1982).

flushing are presented in Section 5.4.1. Assessment techniques for predicting ecological impacts are discussed in Sections 4.2 and 4.3 and mitigative measures are presented in Sections 5.4 and 5.5.

Item 3 - Intended Use

The intended use of the marina may affect permit approval, particularly in coastal areas where public access is limited. Mitigative measures pertinent to public access are discussed in Section 5.4.3. Projects that allow public access to coastal waters are typically viewed as a positive factor in the permit evaluation process.

Item 4 - Size

The size of the marina is dictated by the number, size and type of boats to be accommodated. Land area requirements depend on the harbor function and the facilities necessary to support that function (Lee, 1969). Marinas typically require one acre of upland area for each acre of submerged area. An ideal marina site would have adequate upland area available for the necessary shoreside facilities and for nonessential facilities such as picnic areas and playgrounds. The site should provide adequate area for future expansion of the marina facility. To obtain permit approval, it may be necessary to provide land for wastewater treatment facilities, solid waste disposal, stormwater retention and runoff control and dredge material containment. In some USEPA Region IV coastal states, the size of the proposed marina determines the complexity of the permit review process and the amount of information required to support the permit application.

Item 5 - Types of Boats

The various types and sizes of boats to be accommodated will affect the choice of marina location and marina design considerations. The type of mooring also influences the size of mooring area required. Deeper access channels and harbor depths are required for larger power boats and sailboats with fixed keels. Sailboats also require wider channels that should be oriented perpendicular to prevailing winds to allow for tacking (Rogers et al., 1982). Reasonable proximity to open waters, relatively straight access channels with broad turns and few shoreline hazards are considerations for safe navigation for sailboats and larger power boats. Turning areas within the harbor can be smaller for double screw power boats and sailboats because these need less room to turn than single screw powerboats. These considerations will affect the amount of dredging and submerged area use required for the marina, factors that are directly related to evaluation of potential impacts during the marina permit review process (see Section 4.2.3 for impact assessment techniques pertinent to dredging and Sections 5.4 and 5.5 for mitigative measures).

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The mix of boats to be serviced or accommodated at the marina can affect permitting concerns for potential impacts to water quality and aquatic resources from waste discharges and for potential impacts to aquatic and wetland habitats from boating activities. Impact assessment techniques for predicting pollutant concentrations are discussed in Section 4.2.5. Pertinent mitigative measures are presented in Sections 5.4 and 5.5.

Item 6 - Services and Facilities

The marina concept may include a wide array of services and facilities (Table 3-2). Suitable water and land areas are essential to successful marina development. The marina should be able to handle transient traffic in addition to the regular users. Additional land area also may need to be considered to accomodate any projected future expansion. The particular services and facilities proposed may pose benefical and adverse environmental impacts that could affect permit approval. Facilities for fueling and boat repairs are of particular concern to regulatory agencies because these activities have the potential for water quality and shellfish sanitation problems. Many of the facilities and services that can be found at a coastal marina are illustrated in Figure 3-4.

Impact assessment techniques for pollutants affecting water quality and for predicting the effects of sanitary waste discharges from boats are discussed in Section 4.2. Mitigative design measures pertinent to these activities and mitigative measures during marina construction and operation are discussed in Sections 5.4 and 5.5

Item 7 - Hydrographic Conditions

Tidal range, natural water depth at the site and the projected completed project depth at the marina are hydrographic considerations necessary for evaluating the natural circulation of the area and the projected flushing rate of the marina basin. General offshore hydrography to the 10 to 15-meter (30 to 50-foot) depth may be obtained from U.S. Coast and Geodetic Survey and the Department of Commerce. From 15-meter (50-foot) depths to shore, new surveys may be required because of changes caused by siltation, erosion, marine clay deposits, and shoaling. Bottom movement can be determined by the use of LANDSAT satellite images, available through the National Aeronautics and Space Administration. Images of the area over a period of time can, in some cases, reveal movement of sand bars and changes in the coastline (Blades, 1982). During the hydrographic survey, it is also important to note the locations of underwater hazards or obstructions and to review the past history of the bottom in terms of siltation rates, marine life, bottom growth and shoaling.

TABLE 3-2

MARINA SERVICES AND FACILITIES

MARINA SERVICES

Water Related

- Boat launching
- Mooring service
- Water taxi service
- Transient boat service
- Waste collection
- Fueling
- Boat towing
- Fire and rescue services
- Navigation and weather information

Land Related

- Boat sales
- Boat repairs
- Marina supply sales
- General supply sales
- Trailer storage
- Parking
- Overnight accomodations
- Food service
- Concessions
- Utility service
- Recreational services

MARINA FACILITIES

Water Related

- Open and covered mooring
- Boat launch ramp
- Marine railway
- Crane lift
- Drydock
- Fueling pier
- Anchorage areas
- Marine service station
- Entrance and exit channels
- Swimming area
- Water skiing course
- Basin flushing system
- Storm and wave protection

Land Related

- Boat building and repair
- Boat dry storage
- Trailer storage
- Restaurant
- Motel
- Picnic areas
- Convenience store
- Boat washing
- Parking
- Swimming pool
- Camping
- Beach area
- Club room
- Marine supply sales
- Public toilets and showers
- Recreational facilities
- Bait shop
- Seafood sales

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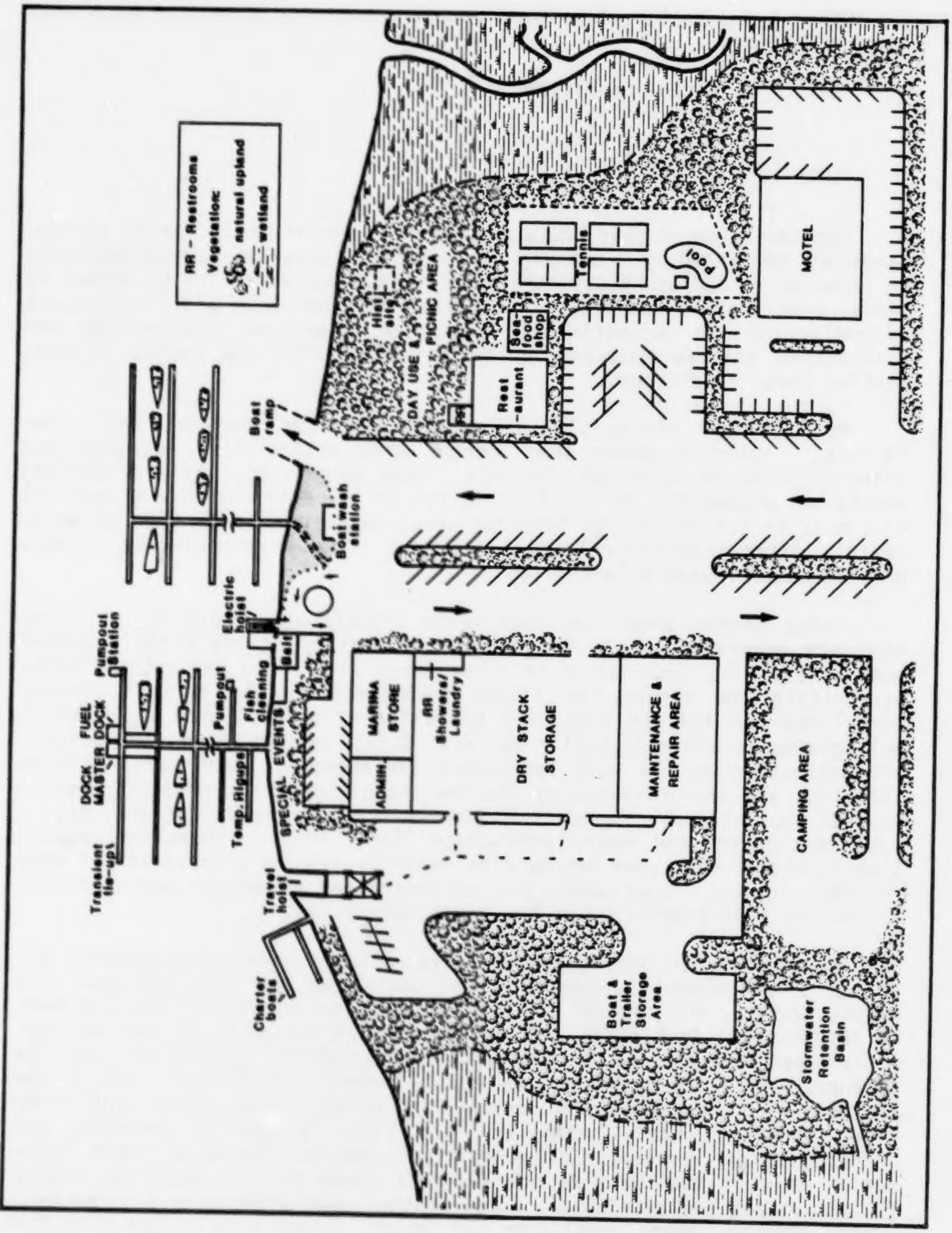
RR - Restrooms
Vegetation:
natural upland
wetland
Charter boats
Travel hoist
Transient tie-ups
DOCK MASTER
FUEL DOCK
Pumpout Station
Pumpout
Temp. Rigups
Fish cleaning
Electric hoist
Bait
SPECIAL EVENTS
Boat wash station
Boat ramp
DAY USE & PICNIC AREA
Hist. site
RR
Rest-aurant
Sea-food shop
Tennis
Pool
MOTEL
ADMIN.
MARINA STORE
RR Showers/ Laundry
DRY STACK STORAGE
MAINTENANCE & REPAIR AREA
CAMPING AREA
Boat & Trailer Storage Area
Stormwater Retention Basin

Figure 3-4. Coastal marina layout illustrating facilities and services.

Other hydrographic considerations necessary for effective site evaluation include:

- Bottom conditions
- Wave action
- Tidal conditions
- Sedimentation patterns
- Shoaling conditions.

Consideration of wave characteristics is important in marina siting. Waves are generated by a variety of sources. Larger waves are generated in large water bodies by offshore storms and other waves are generated by winds, boat traffic and tides. Waves can also generate additional waves by reflecting and resonating off waterside structures. Refraction and diffraction diagram analysis or hydraulic modeling are useful in evaluating these conditions.

Most coastal marina site development must consider sea swell conditions. Habor planning must reduce wave action from entrance and interior bains to acceptable heights. Wave heights for any wave episode should not exceed 0.5 to 1 m (2 to 4 ft) in the entrance channel and 0.3 to 1 m (1 to 1.5 ft) in the berthing area, depending on the type of water craft. Sites with natural entrances in a sound or shielded by islands provide natural wave attentuation.

Large harbor areas can experience troublesome, short-period waves that are generated within the harbor confines by strong winds or power boat wakes. The combination of these waves with tides and outside waves penetrating the harbor can create turbulence in the berthing areas. Turbulence can also be magnified by marina structures such as vertical bulkhead walls and rectangular basins. Sites located where wave heights are decreasing as the wave approaches the shore are most ideal. These locations are characterized by shallow shorelines which gradually deepen towards the entrance. Smooth contours and widening entrances will dissipate wave energy and reduce refraction (ASCE, 1969). Shoreline vegetation is also a good wave energy dissipator as well as a preventer of wave induced erosion. Boat wakes can be controlled by proper marina orientation and boat traffic speed and route regulation.

In addition to hydrographic considerations, physical considerations at the site include assessment of the topography and soil geology. The nature, extent, and cost of the substructures necessary for the site must be determined. Test piles and direct soil evaluation tests are two commonly used methods for determining the resistive quality of subsoils (Chaney, 1961; Chamberlain, 1983). Landside topography should be suitable for protecting the marina from strong winds, tidal and river flow, flooding, heavy water traffic, floating debris, erosion, and changing water levels. Soil conditions should provide suitable foundation support and wastewater treatment capacity, if existing sewage facilities are not available. Local weather conditions must also be evaluated because severe conditions can impact suitability of the site for development.

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Generally, there are few locations where tidal conditions render the use of a marina impractical. The planner must, however, consider additional changes due to winds in shallow areas. The location of the extreme and normal tidal ranges influence the site depth requirements and the design elevation of waterside structures and mooring lines.

Adequate identification and mapping of these parameters will facilitate selection of the best site and allow for maximum use of existing natural conditions during design of the marina. This, in turn, may help minimize or avoid water quality or dredging-related permitting issues. A technique for predicting flushing rates is presented in Section 4.2.1. Methods for predicting sediment deposition and shoaling rates are discussed in Section 4.2.2. Mitigative measures for potential flushing- and dredging-related problems are presented in Section 5.4.

3.4.2 Part Two - Potential Permitting Issues

After development of the marina concept and identification of potential sites, responses to the Screening Checklist, Part Two, Questions 1 through 15 will identify potential permitting issues or indicate where additional information should be obtained. This should provide assistance in final site selection, site feasibility analyses and marina design.

Federal involvement in the coastal marina permitting process derives primarily from Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. Section 10 authorizes the U.S. Army Corps of Engineers (USACOE) to regulate virtually all work including dredging, filling and construction of any structure in, over and under navigable waters of the United States. Section 404 of the Clean Water Act authorizes the USACOE to issue permits for the discharge of dredged or fill materials into U.S. waters. Individual states are authorized to issue 401 water quality certifications for permits as required under Section 404. The 401 water quality certification certifies that the proposed discharge(s) will not affect water quality so as to violate any state water quality requirement for navigable waters into which the discharge(s) will occur. These state water quality requirements as described in the Clean Water Act involve:

- Effluent limitations
- Attainment and maintenance of water quality
- Performance standards
- Toxic pollutant effluent standards.

Most USEPA Region IV coastal states also administer state dredge and fill permit programs independently or jointly with the Section 10/Section 404 program.

Evaluation factors considered in the permit review process include:

- Conservation
- Economics
- Aesthetics
- General environmental concerns
- Wetlands
- Fish and wildlife values
- Flood damage prevention
- Welfare of the general public
- Cultural and historic values
- Shoreline protection
- Recreation
- Land use
- Water supply
- Water quality
- Navigation
- Energy needs
- Safety
- Food production.

Regardless of the permitting authority involved, this review process provides for consideration of water quality issues and impacts to fish, shellfish and recreation. A complete discussion of federal and state regulatory/planning processes and permitting programs is presented in Chapter 6.0, Regulation.

Question 1 - Dredging

Dredging activities may impact water quality, aquatic and wetland habitat resources by altering water circulation patterns, increasing turbidity or siltation, decreasing dissolved oxygen, releasing pollutants from sediments and increasing erosion or shoaling rates. Because of the variety and nature of impacts that may result, preferred marina sites would be those requiring little or no dredging. Such sites would include those located on existing channels or upland areas located adjacent to deep water 2 to 3 meters (6 to 8 feet) or greater. Acceptable marina sites must be located within areas that provide safe, easy and convenient access to waterways. The site also should provide an area of sufficient depth to permit safe access and moorage for boats. Sites on long, winding channels or with shallow water or bottom conditions that hinder safe navigation may require extensive modification and should be avoided. Straightening winding channels can affect basin water circulation patterns, tidal flows and sedimentation characteristics. Areas with known high siltation or shoaling rates also should be avoided because considerable maintenance dredging may be required. Where dredging is necessary, preferred areas would be those where shellfish, other benthic invertebrates or seagrasses would not be affected. Impact assessment techniques pertinent to dredging activities and shoaling rates are discussed in Sections 4.2.2, 4.2.3 and 4.5.2.

Dredging activities require a Section 10 permit. Section 404 review and a Section 401 water quality certification also are required when dredged material is discharged into waters of the U.S. including wetlands. Dredging of vegetated wetlands or seagrass areas is considered undesirable by most regulatory agencies. Minimal alteration of wetland areas may be allowed if the applicant can demonstrate that no other alternatives exist. When unavoidable loss of wetland habitat occurs, creation of new wetland areas may be considered acceptable mitigation. However, this type of mitigation can be prohibitively expensive and may preclude the feasibilty of site development. Mitigative measures for dredging-related impacts are discussed in Sections 5.4.1 and 5.4.2.

Question 2 - Filling

Filling activities may cause temporary impacts to aquatic habitat resources through increased siltation and to water quality resources through increased turbidity, decreased dissolved oxygen or release of pollutants from the fill material. However, the principal concerns for adverse impacts from filling are related to the modification or loss of shallow aquatic areas or wetlands. These areas are highly productive and serve as nursery areas. Because of the significance of adverse impacts to these resources, preferred marina sites would have adequate upland area for marina development and future expansion and present natural characteristics conducive to eliminating or minimizing fill requirements. Impact asessment techniques are discussed in Section 4.3.3. Mitigative measures applicable to minimizing habitat losses are discussed in Section 5.4.2.

A Section 404 permit, administered by the USACOE to regulate discharges of dredged or fill material and a Section 401 water quality certification are required for filling activities in navigable waters of the United States, including wetlands. If filling is associated with dredging and/or other construction activities in navigable waters, a Section 10 permit also is required. Filling of shallow water areas or wetlands is considered unacceptable by regulatory agencies and should be avoided when any alternative exists. Unavoidable modification of these areas may require mitigative measures to compensate for habitat loss (see Section 5.4.2).

Question 3 - Dredged Material Disposal

Dredged material disposal can be a significant issue. Open water disposal is generally not viable because of cost. Disposal on wetlands is unacceptable because of environmental reasons. Therefore, the preferred marina site would be located near a currently permitted upland disposal area. The potential impacts from dredge material are essentially the same as those for dredging activities.

A dredging activity in navigable waters with disposal at an upland site or near the marina site would require a USACOE Section 10 permit if the sediments are nontoxic and the dredge material is contained. A state 401 certification also can be required. Upland disposal of hydraulically dredged material would require the additional Section 404 review and Section 401 water quality certification because of the discharge from the disposal site to waters of the United States. Early consultation with the District Engineer would facilitate marina planning.

Adequate disposal areas for initial and all maintenance dredging should be secured and designated for the life of the project. Upland areas are preferred dredged material disposal sites for initial and maintenance dredging because metals, hydrocarbons or other pollutants that have accumulated in the spoil sediments are less likely to reenter the water. Also, upland sites typically result in the loss of resources of lesser significance. In localities where pollutants in the sediments may be insignificant, the dredged material may, in certain instances, be used for beach nourishment or to create spoil islands suitable for waterbird nesting rookeries. Productive use of dredged material may be viewed as a positive factor in permit application evaluation. Mitigative measures for dredged material disposal are discussed in Sections 5.4 and 5.5.

Question 4 - Structures

Protective structures such as bulkheads and breakwaters may impact water quality and habitat resources through alteration of natural areas or water circulation patterns, or by increasing turbidity, shoaling or erosion. Some sites may require modifications to the shoreline to either create additional land area or stabilize shore erosion. Bulkheads and revetments are commonly constructed for this purpose. Because they are constructed at the land/water interface and may disrupt the flow of water, detritus and biota into or out of a wetland, care must be exercised to minimize impacts to both aquatic and terrestrial habitats. Breakwaters, which may be required to create a safe moorage area with minimum wave and surge action, also may disrupt water flow or migration of organisms. Where littoral drift or shoaling is present, jetties or groin construction may be necessary to control beach movement or maintain access to open water. However, groins and jetties may accelerate or induce accretion or erosion problems on the adjacent shoreline. Proper design is needed to permit littoral bypass around the entranceway. Preferred marina sites would be those affording good natural protection, which could eliminate or minimize the need for protective structures such as bulkheads, revetments and breakwaters.

Construction of any structure in navigable waters of the U.S. requires a Section 10 permit from the USACOE. Impacts from structures proposed in conjunction with marina development are considered in the Section 10/Section 404 permit review process. Design and placement of structures to promote water exchange, minimize habitat loss, shoaling and erosion, and allow migration of organisms is preferred. Impact assessment techniques related to the placement of structures are discussed in Sections 4.2.4, 4.3.3 and 4.5.2. Mitigative measures are discussed in Section 5.4.1 and 5.4.2.

Question 5 - Flushing

Pollutants may enter marina waters in discharges from marine sanitation devices and bilges. These pollutants may adversely affect water quality through decreasing dissolved oxygen concentration and increasing turbidity, coliform bacteria levels and nutrient, metal or hydrocarbon levels. The potential for water quality problems is higher in areas with low flushing rates such as dead-end channels or canals and the upper reaches of estuaries or tidal creeks, which may be characterized by low tidal range or low net flow. Preferred sites are those on open water or near the mouths of tidal creeks or tributaries. For sites on open water, convex shorelines are preferable to concave shorelines. Within the protection of barrier islands, preferred sites would be near inlets where tidal flushing is high. Marina design should maximize natural circulation to reduce sedimentation and maximize dispersion of pollutants. Methods for evaluating impacts from pollutants are discussed in Section 4.2.1 and mitigative measures are discussed in Section 5.4.1.

Question 6 - Water Quality

The Clean Water Act requires that states adopt water quality standards in order to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. A water quality standard defines the water quality goals for a particular water body by indicating its use and by setting criteria necessary to protect that use. The water quality standards program through the antidegradation policy requires that existing uses be maintained. Existing uses are those uses that actually have been attained since 1975. Existing uses are determined by the states who have responsibility for identifying uses and when they are actually attained. A more detailed discussion of the antidegradation policy is found in Section 6.3.3 under "Marinas, Shellfish Harvesting and Antidegradation."

The water quality standards program is designed to protect designated and existing uses. In marina permitting actions (Section 404 and certain Section 10 permits), states are asked to certify (Section 401) that marina projects will not violate established criteria or preclude existing uses of the area's waters. This certification is required for a permit to be issued. Denial of Section 401 certification results in denial of a federal permit.

Buffer zones have been used in Region IV to protect public health. Shellfish harvesting for human consumption is closed within the boundaries of buffer zones. These buffer zones have been used when attainment of applicable water quality standards is dependent on certain waste treatment facilities (such as marine sanitation devices). This concept has also been used to protect public health surrounding marinas. Applicable water quality standards and criteria remain in effect within buffer zones.

Each of the above elements of the water quality standards and public health protection programs affects the permitting of marinas. Where a marina is proposed in waters that are currently used for shellfish harvesting or primary contact recreation, bacterial contamination can become a significant issue. Control of bacterial sources and proximity to the actual use area are the important factors in determining whether the marina is to be permitted.

Obtaining permits for marinas in marginal water quality areas or in sensitive areas where maintenance of water quality is critical for protecting natural resources such as shellfish or grassbeds may require extensive design modifications, including extensive and expensive pollutant control mitigative measures. Impact assessment techniques are presented in Section 4.2 and mitigative measures are discussed in Sections 5.4.1 and 5.5.1.

Question 7 - Protected Areas

Fish or wildlife in designated wildlife refuges, wilderness areas or other specially designated protected areas can be affected by marina construction and operation. The potential for adverse impact is directly related to the proximity of the marina to these areas. Protected areas may be readily identified through contacting state wildlife agencies, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Impact assessment is discussed in Section 4.3.4.

Impacts to the fish and wildlife in protected areas are considered in the Section 10/Section 404 permit review process. A proposed marina near a protected area may require mitigative measures in order to obtain a permit. These measures may include design modifications, seasonal construction scheduling or seasonal modifications in operational activities to ensure the avoidance of adverse impacts. Mitigative measures are discussed in Sections 5.4.2 and 5.5.2. This potential permitting issue can be avoided during the site selection process.

Question 8 - Rare, Threatened or Endangered Species

Birds are the primary group of endangered species that may be of concern in marina siting. Many waterbirds, such as pelicans, ospreys, terns and herons are on state and federal lists of protected species. The West Indian manatee is an endangered aquatic species of significant concern particularly in Florida. This generally slow moving mammal concentrates in springs, power plant discharges and other warmwater areas in Florida during the winter. Impacts on manatees or the habitat necessary to support them may result from marina construction, operation or boating activities. Impact assessment techniques are discussed in Section 4.3.4. Manatee concentration areas may be conveniently identified through contacting state wildlife agencies, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Proposed marina sites should avoid these areas.

Potential impacts to rare, threatened, endangered or otherwise designated outstanding or unique species or habitats are considered as part of the Section 10/Section 404 permit review process. Significant impact to any of these areas or species would be unacceptable. Circumstances may arise when mitigation of potential impacts would be acceptable. Potential mitigative measures are discussed in Sections 5.4.2 and 5.5.2. However, sites where potential impacts could occur would ideally be eliminated from consideration.

Question 9 - Shellfish

Changes in water quality can result from marina construction and operation and from boating activity. Changes that have the potential to impede shellfish growth and propagation include increased turbidity, siltation, water turbulence and pollutant levels. Sanitary waste discharges can contaminate harvestable shellfish such as oysters and preclude commercial harvesting of this resource without depuration of the contaminated oysters (depuration is achieved by holding oysters in clean water for specified periods of time to cleanse them of pollutants; see Appendix C). Locating marinas away from areas used by sport or commercial interests will reduce the potential for both environmental impacts and resource-use conflicts. Impact assessment techniques that may be used in evaluating the potential adverse effects from dredging operations and direct discharge of sanitary waste are discussed in Sections 4.2.3 and 4.2.5.

Potential impacts to shellfish resources are considered in the Section 10/Section 404 permit review process, 401 water quality certification and in state permitting programs when separate programs exist. Most USEPA Region IV coastal states prohibit shellfish harvesting within specified distances from marinas. The majority of state shellfish sanitation agencies establish these buffer zones on a case-by-case basis. Public health concerns are the basis for closures. South Carolina uses a radius of 305 meters (1000 feet) although other distances may be approved. The size of buffer zones in other states is variable. Criteria used to determine closure areas are established by the states and include consideration of the U.S. Food and Drug Administration, National Shellfish Sanitation Program "Approved Area" criterion (USFDA, 1972). State criteria and policies are discussed in Section 5.4.2.

Marina sites within 610 meters or 2000 feet of shellfish beds have the potential to raise public health issues affecting permit approval. The state closure policies for shellfish beds in the vicinity of marinas also may result in resource-use conflicts with shellfishing interests because commercial and private harvesting is prohibited in closed areas. These conflicts have been avoided by restricting marina development within specified distances of viable shellfish beds. Within USEPA Region IV, Mississippi does not permit marinas within 1000 feet of shellfishing areas. The state of Maryland uses variable distances based on the survival time of coliform bacteria and the size of the marina. Marinas with less than 50, 51 to 100 and more than 100 boats may not be located closer than 201, 402 and 805 m (660, 1320 and 2640 ft), respectively, to shellfish beds. A detailed discussion of the application of the antidegradation policy to marinas proposed in shellfish harvesting waters is found in Section 6.3.3 under "Marinas, Shellfish Harvesting and Antidegradation."

Locating access channels near shellfish beds also may result in issues related to environmental impacts from boating traffic. Intertidal oysters are largely restricted to a relatively narrow vertical range midway between mean low water and mean high water. This is the same area where breaking waves impart maximum energy to the shoreline. Power boats operated in a manner that produces large wakes can disturb the oyster shells with newly attached spat (oyster larvae) and can damage fragile shells of the spat. Wave action can also seriously affect adult oysters and their habitat. Wake action increases the energy imparted to the shoreline, often resulting in removal of the fine-grained substrate suitable for oyster habitat. Coarse-grained, sandy substrates are not suitable for oysters. The net result of increases in boating activities can be the destruction of the intertidal oyster resources. Sloping shorelines paved with old oyster shells are a common sight along well-traveled waterways. Marinas should not be located where increased boat traffic would damage the production of intertidal oysters. Mitigative measures are discussed in Sections 5.4.2 and 5.5.2.

Question 10 - Grassbeds

Increased turbidity, pollutants and physical damage from boats may damage grassbeds. Seagrasses are considered to be sensitive resources because of their role as nursery areas and their slow recovery following impacts. Marina sites in locations where disruption of highly productive nursery areas such as seagrasses, marsh grasses and mangroves will not occur are preferred. Techniques applicable to estimating impacts are discussed in Section 4.2.3.

Potential impacts to grassbeds are considered in the Section 10/Section 404 marina permitting process. The dredging of access channels through grassbeds is unacceptable to regulatory agencies. Obtaining permit approval for marinas near grassbeds will required close consideration for potential impacts and may require mitigative measures which can affect the financial feasibility of the project. Mitigative measures are discussed in Sections 5.4.2 and 5.5.2

Question 11 - Historic, Archaeological and Scenic Areas

Proposing a marina development in a recognized area of historic, archaeological or scenic value is a factor considered by permitting agencies. A finding of significant impact may cause a Section 10/Section 404 permit to be denied. As part of the permitting process the USACOE considers impacts to these resources that may result from marina development. Under Section 106 of the National Historic Preservation Act, State Historic Preservation Officers (SHPO) have responsibilities for reviewing proposed developments to determine possible adverse impacts. The marina developer or site planner can readily identify these areas by contacting the SHPO. The SHPO can identify sites that could give rise to significant permitting issues or recommend an appropriate professional with knowledge in the local area who may be consulted. Impact assessment techniques are discussed in Section 4.4. If the proposed marina location is in a critical area, mitigative measures discussed in Section 5.4.3 may be acceptable.

Question 12 - Local Opinion

An important consideration in site planning is the opinion of local landowners. Identification of adjacent property owners is a required part of the marina permit application. Early consultation with local residents and landowners may be important to project success. Informed residents who have the opportunity to participate in shaping the proposed development can be an asset to the marina developer. Other mitigative factors that can serve to enhance public opinion are discussed in Sections 5.4.3 and 5.5.3.

Issuance of a Public Notice is required in the USACOE permit review process. The purpose of this notice is to allow regulatory agencies, individuals and special interest groups to comment on the proposed development. Public opposition to the project may lead to public hearings, require significant project modifications or ultimately result in permit denial.

Question 13 - Consistency with Coastal Zone Management, Local Permits and Approvals

After the best of the candidate sites has been selected, early evaluation of consistency with state and local coastal zone management plans and local ordinances and zoning requirements is important in determining site feasibility. The USACOE permit review process requires a determination that the proposed project is consistent with state coastal zone management plans. State and local requirements can be identified by contacting respective coastal zone management offices and local planning offices. Failure to obtain all necessary regional and local permits and approvals may result in costly delays in obtaining marina permit approval or result in permit denial.

Question 14 - Public Access

As discussed under Intended Use in Section 3.4.1, considerations for public access affect permit approval. Regulatory agencies look more favorably on a public marina or a private marina that would allow public water-use access (boat ramps or other facilities) than on a proposed marina that would exclude any public use. Provisions to provide or enhance public land access to navigable waters would be viewed by USACOE and state permitting agencies as a positive factor in evaluating permit applications. Projects that obstruct public access could be considered detrimental to the public interest and not approved as proposed. Mitigative measures that might facilitate permit approval are discussed in Section 5.4.3.

Question 15 - Obstruction to Navigation

Structures that extend into existing channels have the potential to obstruct boat traffic. Although it is important that boating activity is or will be sufficient to support the marina, the marina should be sited in such a manner that the marina itself or boats moving to or from the marina will not interfere with traffic along established navigation channels or routes. An acceptable marina site would provide adequate open water for safe navigation. Assessment of impacts to navigation is discussed in Section 4.4.2 and mitigative measures are presented in Section 5.4.3.

Construction or placement of any structure in navigable waters requires a Section 10 permit from the USACOE. If marina development requires placing structures closer than 30 m (100 feet) to a federally-maintained channel or basin, the permit application may be denied or require design modifications before approval, if the structure placement was considered to pose a hazard to safe navigation. These same considerations would apply to potential obstructions to navigation in any existing channel.

3.5 Summary

The typical marina development process encompasses two phases: 1) an initial broad screening evaluation in which market analysis, development of market strategy and marina concept and identification of possible sites occur and 2) a detailed site-specific evaluation in which the proposed site is selected, site feasibility and preliminary marina design are determined, final marina design is completed and development is initiated.

The initial broad screening evaluation of candidate marina sites should consider the anticipated need and demand for the marina. Sites should provide adequate water and land area; water, land and utility access; and aesthetic surroundings. Sites that meet these conditions may then be considered for detailed site-specific evaluations to determine existing site conditions favorable for marina development in an environmentally sound manner. The Coastal Marinas checklist can be used to identify desirable/undesirable site characteristics. Responses to questions in Part Two of the checklist will identify potential permitting problems. This approach leads to site selection and marina design that allow maximum use of existing conditions while minimizing site modifications. This, in turn, will help eliminate or reduce environmental impacts and permitting issues.

Collective environmental and engineering needs at a given marina site are rarely met and alterations are usually required to make the site suitable. The most appropriate marina site would be one requiring as little modification to the site environs as possible. Desirable and undesirable site selection characteristics include:

Desirable Site Characteristics

- Easy access to open waters, population centers, utilities, public sewer and water lines
- Accessible from existing roads and waterways
- On sheltered waters providing adequate storm protection with deep waters close to shore
- Near existing state or federally maintained channels
- Near currently permitted public areas for disposal of dredged material
- High tidal range or flow and high flushing rates, such as near the mouths of estuaries or tidal creeks, near inlets or on convex shorelines
- Compatibility with existing land and water uses
- Away from shellfish beds used for harvesting for human consumption.

Undesirable Site Characteristics

- Too shallow or with inadequate water or land area for intended use, requiring extensive dredging or filling
- Low tidal range or flow and low flushing rates, such as dead-end channels or canals or the upper reaches of tidal creeks
- In a location with poor water quality, marginally meeting state water quality standards
- Near specially designated fish or wildlife protection areas or near shellfish beds or grassbeds
- Location where rare, threatened, endangered or otherwise designated unique or outstanding aquatic or terrestrial species or habitats are found
- In an area of recognized historic, archaeological or scenic value

- Location where development would obstruct public access to navigable waters or hinder safe navigation by requiring structures that would extend into existing channels
- On or adjacent to recognized historic, archaeological or scenic resources.

The two sites in Figure 3-5 illustrate several desirable/undesirable factors in site planning considerations. Proper siting of the marina may be the single most critical factor for environmentally sound coastal marina development. Adequate attention to environmental, engineering and permitting concerns during site planning can avoid costly environmental solutions to development impacts and delays in detaining permit approvals.

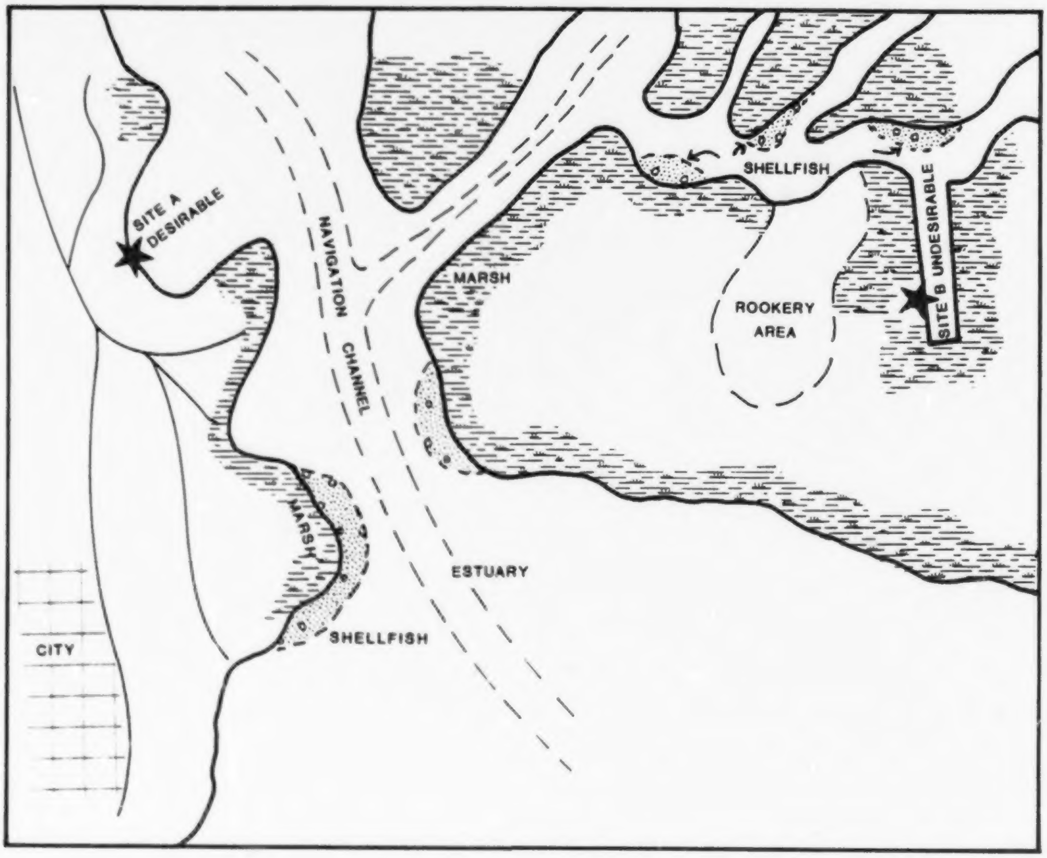
SITE A DESIRABLE
NAVIGATION CHANNEL
MARSH
SHELLFISH
ROOKERY AREA
SITE B UNDESIRABLE
MARSH
ESTUARY
CITY
SHELLFISH

Figure 3-5. Desirable and undesirable site characteristics.

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4.0 ENVIRONMENTAL IMPACTS: ASSESSMENT TECHNIQUES

4.1 Overview

The design, construction and operation of coastal marinas and associated boating activities have the potential for undesirable environmental impacts to the marine and coastal ecosystems in which these activities occur. The potential for environmental impacts and their significance will not be the same for every marina.

This chapter provides the Handbook user with information on the types of impacts that can result from coastal marina development and operation and describes ecosystem responses to these impacts. While many of these impacts can occur from any coastal development and at times may be more significant for developments other than marina projects, the focus of this chapter, and this Handbook, is on coastal marinas, and the impacts are discussed in this context. Also provided in this chapter are basic environmental assessment methods for predicting potential impacts to water quality (Section 4.2), coastal ecology (Section 4.3) and other coastal resources (Section 4.4). These areas of impact are not distinct but can be closely interrelated. An activity having a water quality impact, for example, may likely have ecological impacts as well. Thus, some overlap and repetition in the discussion of impacts in this chapter was intentional.

Some of the impacts assessment methods presented in this chapter, particularly some of mathematical descriptions, are simplifications of more sophisticated techniques. The Handbook user is encouraged to examine the original sources for these techniques as necessary. However, these techniques presented can provide reasonable approximations for screening potential impact problems when site-specific data are not available. The techniques also can be used by decision-makers when evaluating marina permit applications.

The last section (4.5) describes the overall approach to environmental impact assessment, in addition to specific areas of concern related to:

- Water quality
- Stormwater runoff
- Dredging and spoil disposal
- Shoreline and protective structures
- Sanitary wastes from boats
- Boat operation and maintenance
- Ecological impacts.

Supporting appendices for this chapter include Appendix A, which presents measurement techniques for impact categories, and Appendix F, which lists further contacts for information.

4.2 Water Quality Impacts

Many factors work to determine the eventual impact a marina will have on the water quality within the immediate vicinity of a marina and areas of the adjacent waterway. As discussed in Chapter 3.0, initial marina site selection is one very important factor. Selection of a site with favorable hydrographic characteristics and which requires the least amount of modification can do a great deal to reduce potential water quality impacts.

For marinas with enclosed or semi-enclosed basins, the basin configuration is another important factor. Marina basin size and shape are two significant features of basin configuration. The size and shape of marina basins are functions of

- Natural advantages at the site
- Mooring facility requirements
- Required degree of protection from weather and waves
- Land and water area limitations
- Economics.

In such basins, circulation or flushing characteristics play important roles in the distribution and dilution of potential contaminants. Circulation and flushing can be influenced by the natural or dredged basin orientation. The final design is usually a compromise that will provide the most desirable combination of marina capacity, services and access, while minimizing environmental impacts, dredging, protective structures and other site development costs.

Numerous marina-related development and operation activities are also significant factors impacting water quality. Dredging and dredged material disposal, wastewater disposal, fueling operations, stormwater runoff and boat maintenance and repair are some of these. Discharges from marina sanitation devices and bilges can also impact water quality in the marina waters. In inadequately flushed basins, discharges from these sources have the potential to reduce dissolved oxygen supply and increase turbidity, coliform bacteria concentrations, nutrient, metals or hydrocarbon levels.

Descriptive methods for estimating the impact of these factors follow.

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4.2.1 Flushing Characteristics of Marina Sites

Flushing and circulation are important physical characteristics of a marina site that should be considered in marina planning. Precise information on flushing and circulation usually is not readily available during the marina site selection and design process. However, methods exist for providing estimates of expected flushing capability.

The method chosen to estimate expected flushing from a marina site depends upon the hydrographic characteristics of the siting location. Marinas anticipated to be located within a confined area with one or two relatively narrow openings would have flushing characteristics considerably different from marinas located directly on larger bays or estuaries or along river shorelines. Two openings may imporove flushing in semi-enclosed marina basins. Two lock-controlled marinas on Hilton Head Island, SC (Windmill Harbour and Wexford Plantation) use inlet and outlet wiers and pipes located at opposite ends of the marina to flush the basin by natural tidal forces. Methods that may be used to enhance circulation and reduce the potential for buildup of pollutants are discussed in Section 5.2.1.

Semi-Enclosed Marinas

Flushing time for a marina site within a semi-enclosed area can be estimated using simplified dilution calculations. A number of assumptions are required for applying such a simplified solution and these will be listed following presentation of the method. The parameters required for the estimation are:

- Average marina depth at low and high tide following completion of dredging, based upon the representative tidal range for the area
- Volume of non-tidal freshwater inflow into the marina
- Surface area of the marina
- The percentage of discharged water returning to the basin on the following tidal cycle.

Representing the semi-enclosed marina as a basin such as depicted in Figure 4-1, the flushing time can be approximated by the following equation:

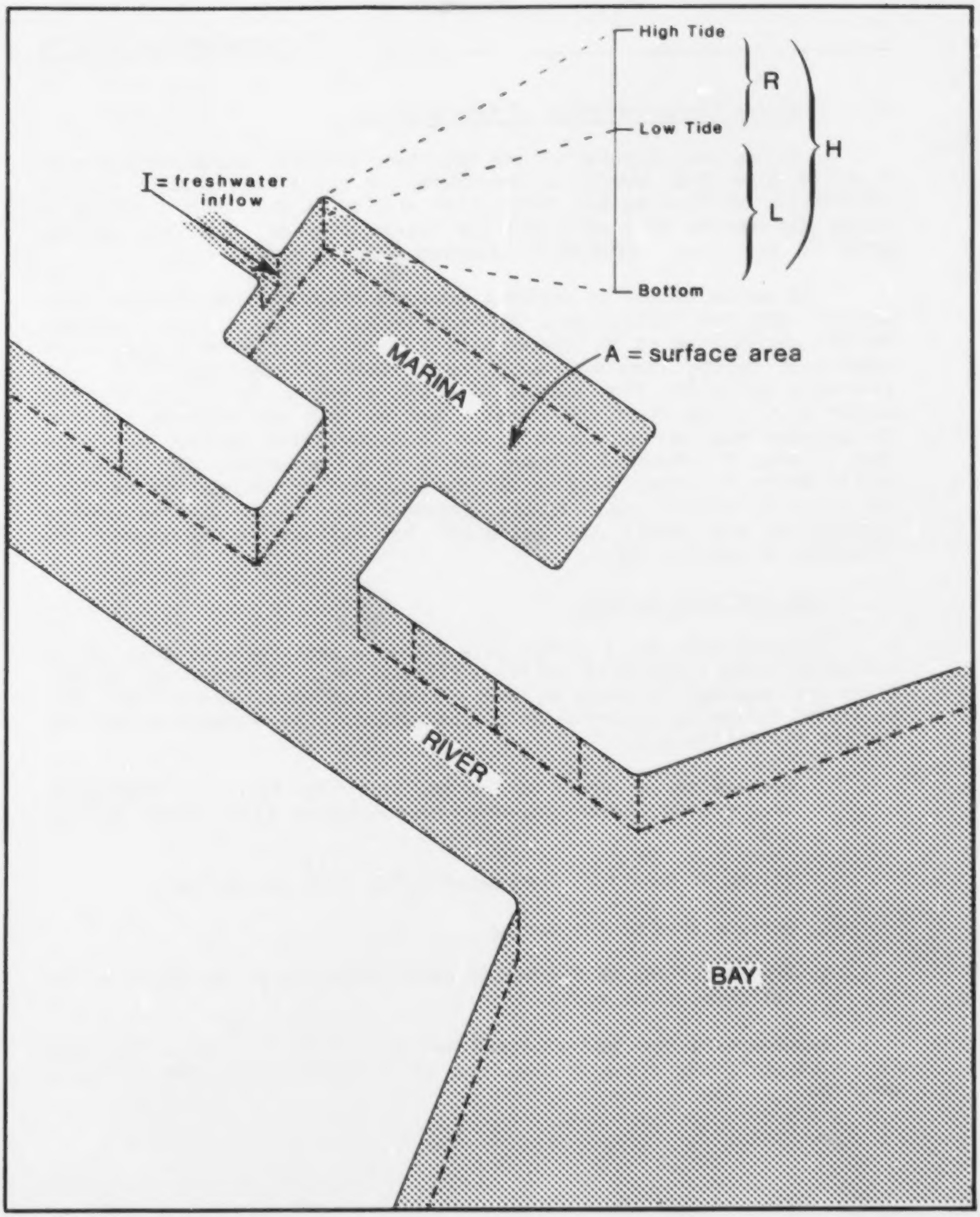
High Tide
R
Low Tide
H
L
Bottom
I = freshwater inflow
A = surface area
MARINA
RIVER
BAY

Figure 4-1. Representative Semi-enclosed Marina Basin

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$$(1) \qquad T_f = \frac{T_c \text{Log} D}{\text{Log}\left(\frac{AL + bAR - IT_c}{AH}\right)}$$

where:
T_f = Time of flushing (hours)
T_c = Tidal cycle, high tide to high tide (hours)
A = Surface area of marina (m^2)
D = Desired dilution factor
R = Range of tide (m)
b = Return flow factor (dimensionless)
I = Non-tidal freshwater inflow (m^3/hour)
L = Average depth at low tide (m)
H = Average depth at high tide (m).

The parameter "b" represents the percentage of the tidal prism ("AR" in Equation 1) that was previously flushed from the marina on the outgoing tide and is expressed as a decimal fraction. For example, if the river depicted in Figure 4-1 had a relatively low flow rate, water discharged from the marina at the completion of one tidal cycle may still exist in proximity to the marina inlet and portions may flow back into the marina on the incoming tide. This water mass portion would not be considered as aiding flushing for water quality considerations.

Non-tidal freshwater inflow from runoff or stream discharge into the marina basin can be estimated using techniques described under Runoff. Frequently this number is small compared to tidal flushing. If "ITc" is much less than "AL + bAR," this component of the equation can be ignored and the simplified equation is as follows:

$$(2) \qquad T_f = \frac{T_c \text{Log} D}{\text{Log}\left(\frac{AL + bAR}{AH}\right)}$$

where: parameters are as defined previously.

One assumption of Equations (1) and (2) is that the physical marina shape includes relatively vertical sides, particularly from the low to high water marks. If this is not the accepted case, Equation (2) is represented as the following:

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$$(3)\qquad T_f = \frac{T_c \operatorname{Log} D}{\operatorname{Log}\left(\dfrac{V_L + bV_p}{V_H}\right)}$$

where: T_f, T_c, b and D are as defined previously
V_L = Volume of marina at low tide (m^3)
V_H = Volume of marina at high tide (m^3)
V_p = Volume of marina tidal prism ($V_H - V_L$).

This simplified approach to estimating flushing incorporates the following assumptions:

- The tidal prism volume completely mixes with basin waters
- The pollutant concentration decreases with each tidal dilution but will never completely flush
- The marina basin is fairly uniform with relatively vertical sides (Equations 1 and 2)
- The influx of non-tidal freshwater serves to decrease the polluted volume without affecting the level of tide
- The majority of flushing is due to tidal flow.

The most difficult parameter to determine may be the value of "b", the return flow factor. This value may be determined by dye tracer tests for the actual marina or it can be estimated based upon the circulation characteristics of the affected water bodies. For openings into rivers such as depicted in Figure 4-1, values of "b" may be greater than 0.5 for low flow rivers or less than 0.5 if the river flow is high or receiving water circulation is fast. Without definitive field data, subjective estimations would have to be made. For example, if ebb flow is at least 50 percent faster than flood flow, flushing should be fair and a value for "b" would probably be less than 0.5. The value for "D" should be chosen depending upon the amount of flushing desired. If complete flushing is desired, a very low value of "D" can be selected, such as 0.01. Since the remaining pollutant concentration will be diluted by each tidal cycle, complete flushing will be approached asymptotically, so a reasonable cutoff value for dilution must be chosen.

Based on the previous equations, the estimated flushing time for a marina is an approximate value. Many characteristics of the marina site, including location relative to other water bodies, ambient water quality, biological activity, total volume and expected marina activity, and type and volume of discharge, would all affect flushing time. For most cases a two to four day flushing time is satisfactory while longer flushing times may not be acceptable (Boozer, 1979). Evaluation of the buildup of particular toxic pollutants or the decrease in dissolved oxygen would be required to better evaluate the adequacy of flushing for enclosed marina sites.

Open Marinas

Marinas that are located directly on rivers, bays or estuaries and are not entirely enclosed by protective barriers would have flushing characteristics generally similar to those for the water body.

Characterization of the actual flushing potential of a specific area within a large body of water such as a river, bay or estuary cannot be determined without detailed knowledge of the specific site and surrounding areas. However, estimates of area flushing times can be made using one of a number of available models for estuary flushing and computing the individual segment flushing time for the area in question. An example of such a model is the fraction of freshwater method (USEPA, 1982).

This method assumes that as fresh river inflow enters the estuary an equal amount of estuary water is discharged and this freshwater flow is the primary flushing vehicle. The estuary being studied is divided into segments. The choice of segment size is determined by salinity gradients. The higher the gradient, i.e. the more rapid the salinity change over distance, the smaller the segment size. The total flushing time for the estuary, or part of the estuary, is found by summing the individual segment exchange times within the estuary, or within parts of interest, as follows:

$$(4) \qquad T_f = \sum_{i=1}^{n} \left[\frac{\dfrac{\underline{S_w - S_i} \times V_i}{S_w}}{I} \right] \qquad \text{(USEPA, 1982)}$$

where:

T_f = Flushing time of total water body (hours)
S_w = Sea water salinity (ppt)
S_i = Mean salinity in the segment (ppt)
V_i = Volume in segment i (m^3)
I = River discharge (m^3/hour)
n = Number of segments.

In order for the marina planner to use this flushing estimation method for evaluation of a particular site in an estuary or river, some field data are required. Salinity values must be established both for the computations using Equation (4) as well as for decisions regarding the segmentation of the water body. In addition, representative values of river discharge into the estuary are required. Generally, the flushing time should be calculated using a representative low-flow situation for the river, as this would provide a conservative "worst case" type of situation for flushing.

Some of the assumptions used in this method are:

- Uniform salinity throughout the segment
- During each tidal cycle a volume of water equal to the river discharge during one tidal cycle is moved through each segment, displacing the same amount of water
- The water in the segment is completely mixed instantaneously following displacement
- Localized stagnant areas are not considered to exist.

Another computational method which does not require knowledge of salinity distribution in the estuary is the modified tidal prism method. However, this method requires more detailed information on the physical characteristics of the estuary so that various segment volumes can be determined. This method is not described in detail because it requires that calculations be made for the entire estuary rather than selected segments. Details of this method are provided by USEPA (1982).

4.2.2 Sediment Deposition and Shoaling

A variety of factors influence the amount and location of sediment deposition in a marina area. Since marina sites are generally chosen or designed to be relatively quiescent, they become efficient sediment traps. Sediments can be transported into the marina through suspended or bed load hydrodynamic transport or by upland storm runoff. Shoaling at harbor entrances can occur when breakwaters or entrance channels affect normal littoral drift of sediments (Figure 4-2). Sediment control measures such as groins or jetties may be required at some sites where suspended load or bed load sediment transport is high.

Suspended and Bed Load Sediment Transport

Semi-Enclosed Marinas

Estimates of suspended load sedimentation in a semi-enclosed marina basin can be obtained through the use of two characteristics, the total suspended solids of the water being carried into the marina basin and the percentage retention of these solids within the basin. Sedimentation within the basin due to biological activity is not considered. Using Stokes Law for determining the terminal velocity of a particle settling in a fluid and making some assumptions concerning the particle and fluid allows determination of the relationship presented in Figure 4-3. The assumptions used are that the particles are spherical and the density of the fluid throughout the water column is uniform. Dispersion, advection and interference of settling are not considered. The density of the particle is assumed to be 2.0 gm/cm^3. This is a representative value for a particle between the density of sand and inorganic detritus (USEPA, 1982). Most variations from these assumed conditions would result in a lower predicted sedimentation rate.

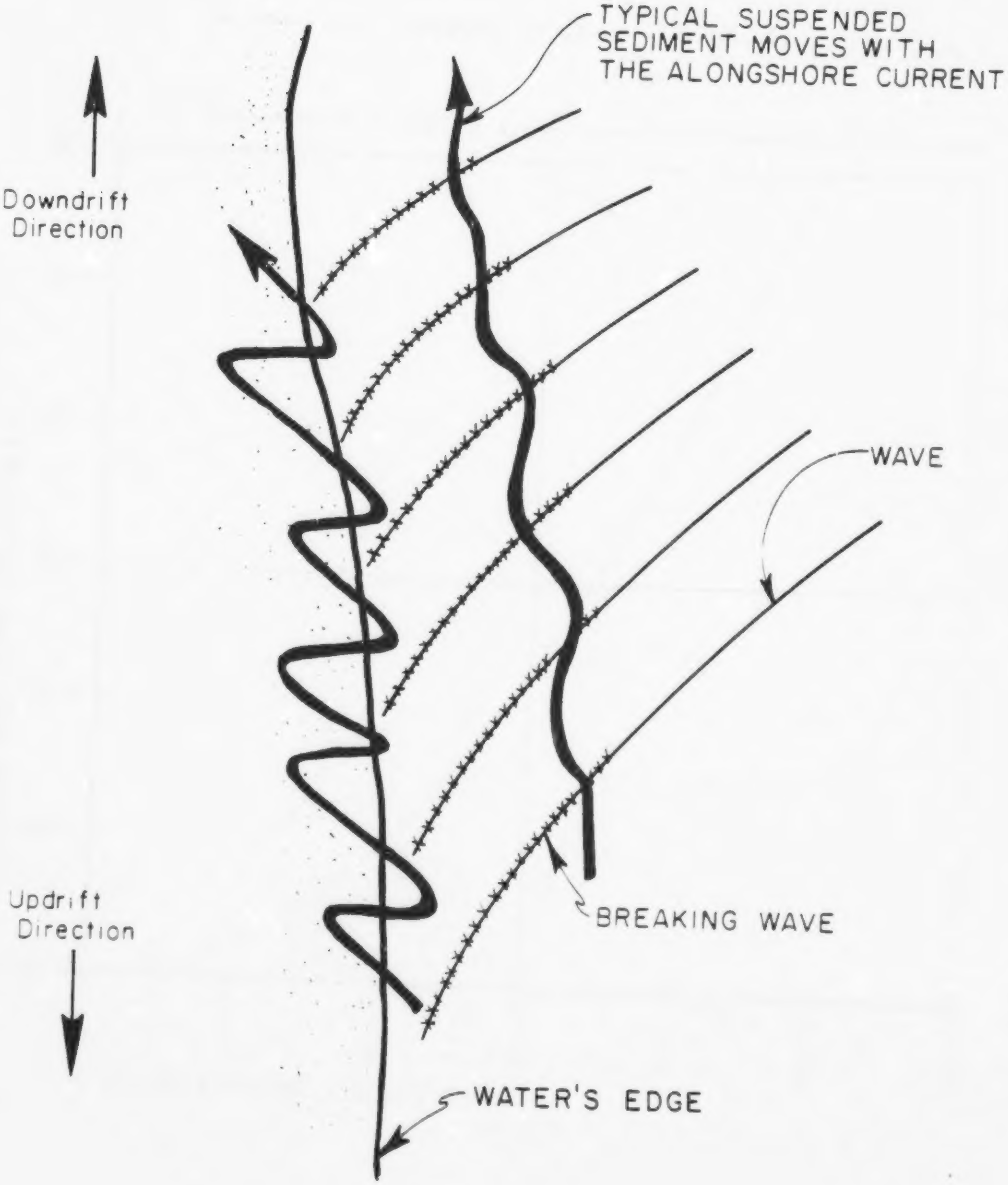
TYPICAL SUSPENDED SEDIMENT MOVES WITH THE ALONGSHORE CURRENT
Downdrift Direction
WAVE
Updrift Direction
BREAKING WAVE
WATER'S EDGE

Figure 4-2. Alongshore sediment transport (Adapted from USACOE, 1982a).

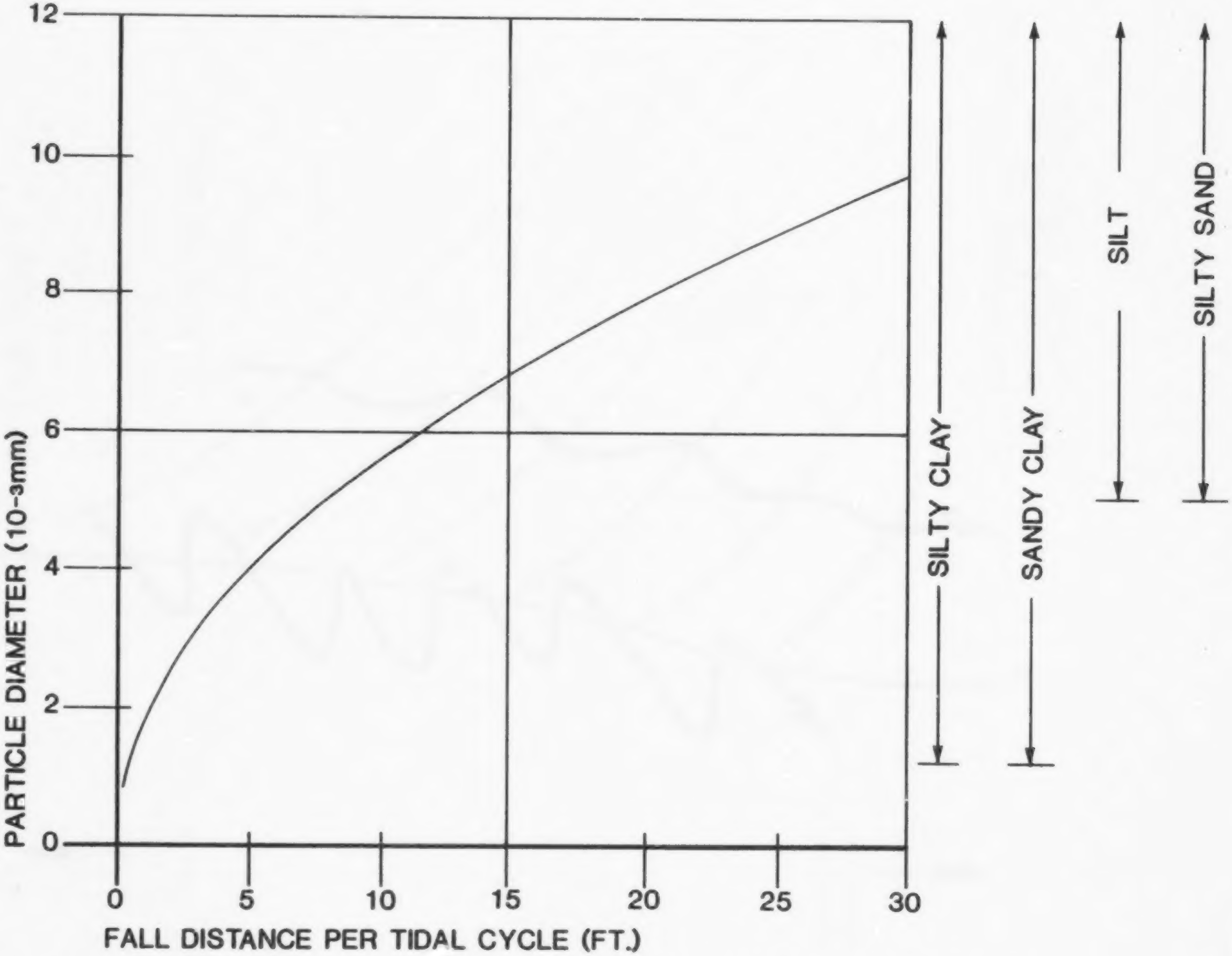

Figure 4-3. Particle diameter vs. settling fall per tidal cycle (12.3 hrs.) under quiescent conditions (spheres with density 2.0 gm/cm^3), (Adapted from USEPA, 1982).

Based upon the information provided in Figure 4-3, it can be estimated that most of the suspended sediment load with particle diameters greater than the lower limits of silty clay and sandy clay, about 4 x 10^{-3} mm, would be deposited in an enclosed marina during one tidal cycle of about 12.3 hours. For a conservative estimate of suspended load sedimentation in the marina basin, a retention of 100 percent can be assumed. The estimated sedimentation rate of the suspended load within the marina basin can be determined by:

$$S_s = F_5 \, VmTSS/T_f \qquad (5)$$

where: S_s = Suspended load sedimentation rate (kg/day)

V_m = Volume of marina at mean depth (m^3)

TSS = Total suspended solids in waters flushing into the marina basin (mg/l)

T_f = Flushing time (hours)

F_5 = 0.024 (converts units to kg/day).

Open Marinas

Sedimentation of the suspended load for marinas located on more open areas of an estuary, bay or river would be affected by local conditions. In estuaries, sedimentation of suspended load will be greater in the upper estuary near the point of river influx because the water velocity decreases at this point and many of the suspended particles will settle out. This also occurs at tide nodal point. Sedimentation also will be greater near the point of freshwater-saltwater interface in the estuary where rapid change in salinity causes flocculation of the suspended particles. Marinas sited near these locations would be subject to high sedimentation rates. Available records can be reviewed to determine historic and therefore expected sedimentation in these areas.

Bed load transport is the descriptive term for sediment which is moved along the bottom by currents. This sediment movement is a complex process that is affected by particle size, channel or bottom geometry, relative layering of various particle sizes, bottom growth or other obstructions, near-bottom current velocities and suspended particle composition of the near-bottom currents. Simple methods for estimating bed load transport are not available. For rivers, however, it is commonly five to 25 percent of the suspended sediment movement, although it may be much higher (Linsley and Franzini, 1979).

For marinas that are semi-enclosed with entrance channels perpendicular to rivers, bed load transport may be significant in filling the dredged entrance channel. For natural entrances and for marinas located on rivers or in bays or estuaries, the bed load transport would probably not create a buildup of sediments unless structures were added that significantly altered bottom flow patterns.

Runoff

Stormwater runoff can carry particles into the marina basin. These particles would add to the total amount of sedimentation expected. Upland runoff characteristics result from complex interactions between rainfall frequency and intensity, ground characteristics such as vegetation, type of soil, relative compaction of soil, slope of the land, impervious and pervious surfaces and other obstructions.

Without detailed information on the marina site, only a gross estimate of sediment concentrations derived from runoff into the marina basin can be made. The results of a study on urban runoff indicate an average suspended solids concentration of 227 mg/l (Weibel et al., 1966). This concentration of total suspended solids is high, and would represent a high estimate of what would be expected for the marina area. Assuming that this suspended sediment would be retained within the marina basin, estimates can be made for sediment addition to the marina basin from runoff. These estimates require determining the volume of runoff expected for the area.

An estimate of the expected volume of runoff based upon rainfall and physical characteristics of the drainage basin can be made by following the steps outlined below.

1) Determine the hydrologic soil group from Table 4-1 which most closely represents the drainage area around the marina site. Subdivide drainage area into different groups, if necessary.

2) Determine the Runoff Curve Number (RCN) from Table 4-2 which is an indicator of the runoff potential based on physical characteristics of the area. Subdivide drainage area, if necessary.

3) Apply factors for conversion of RCNs for different antecedent moisture conditions. RCNs listed in Table 4-2 are based upon Condition II defined in Table 4-3. Factors for conversion of RCNs for other moisture conditions are listed in Table 4-4.

4) Determine unit runoff in inches from Table 4-5 based upon RCN determined in Step 3 and amount of rainfall expected. Rainfall information will have to be determined from local records for the proposed marina siting area.

5) Convert unit runoff in inches to volume of runoff by:

TABLE 4-1

HYDROLOGIC SOIL GROUPS

SOIL GROUP	CHARACTERISTICS OF SOIL
A	High infiltration rates even when thoroughly wetted; mainly deep, well to excessively drained sand and/or gravels; high rate of water transmission and low runoff potential.
B	Moderate infiltration rates when thoroughly wetted; moderately well to well drained soils with moderately fine to moderately coarse textures; moderate rate of water transmission and a moderate runoff potential.
C	Slow infiltration rate when thoroughly wetted; moderately fine to fine textured soils or soils with a layer that impedes the downward movement of water; slow rate of transmission and a high runoff potential.
D	Very slow infiltration rates when thoroughly wetted; clay soils with a high swelling potential; soils with claypan or clay layer near the surface; soils with a high permanent water table; shallow soils over nearly impervious materials. Very slow rate of water transmission and a very high runoff potential.

Source: USDA, 1969

TABLE 4-2

RUNOFF CURVE NUMBERS (RCN) FOR URBAN AND SUBURBAN AREAS

Land Use		Hydrologic Soil Group A	B	C	D
Lawns, parks, golf courses, cemetaries	Good*	39	61	74	80
	Fair**	49	69	79	84
Commercial and business areas, paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets: paved with curbs and storm sewers		98	98	98	98
paved with open ditch drainage		82	89	92	94
gravel		76	85	89	91
dirt		72	82	87	89
Residential:*** Average lot size	% Impervious				
1/8 acre or less	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
Meadow or idle-good hydrologic condition		30	58	71	78
Woods: good hydrologic condition		25	55	70	77
fair hydrologic condition		36	60	73	79
Newly graded area:		81	89	93	95

* Good grass cover on about 75% of the pervious area.

** Good grass cover on about 50% of the pervious area.

*** Curve numbers are computed assuming the house and driveway runoff if directed toward the street with a minimum of roof water directed to lawns when additional infiltration could occur. Lawns are considered to be in good hydrologic condition.

General note: Antecedent moisture Condition II.

Source: USDA, 1969

TABLE 4-3

DEFINITION OF ANTECEDENT MOISTURE CONDITIONS

Condition	General Description	5-day antecedent rainfall in inches Season Dormant	Growing
I	Optimum soil condition	0.5	1.4
II	Average value for annual floods	0.5-1.1	1.4-2.1
III	Heavy rainfall or light rainfall and low temperatures within 5 days prior to the given storm	1.1	2.1

Source: USDA, 1969

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TABLE 4-4

FACTORS FOR CONVERTING RCN's TO ANTECEDENT CONDITIONS I AND III*

CURVE NUMBER FOR CONDITION II	FACTOR TO CONVERT CURVE NUMBER FOR CONDITION II TO	
	CONDITION I	CONDITION III
10	0.40	2.22
20	0.45	1.85
30	0.50	1.67
40	0.55	1.50
50	0.62	1.40
60	0.67	1.30
70	0.73	1.21
80	0.79	1.14
90	0.87	1.07
100	1.00	1.00

*Source: Barfield and Haan, 1972.

TABLE 4-5

RUNNOFF (INCHES) FOR SELECTED RUNOFF CURVE NUMBERS

RAINFALL (INCHES)	CURVE NUMBER (RCN)							
	60	65	70	75	80	85	90	95
1.0	0	0	0	0.03	0.08	0.17	0.32	0.56
1.2	0	0	0.3	0.07	0.15	0.28	0.46	0.74
1.4	0	0.02	0.06	0.13	0.24	0.39	0.61	0.92
1.6	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11
1.8	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.30
2.0	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48
2.5	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.97
3.0	0.33	0.51	0.72	0.96	1.25	1.59	1.98	2.44
4.0	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.42
5.0	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.41
6.0	1.92	2.35	2.80	3.28	3.78	4.31	4.85	5.40
7.0	2.60	3.10	3.62	4.15	4.69	5.26	5.82	6.40
8.0	3.33	3.90	4.47	5.04	5.62	6.22	6.81	7.39
9.0	4.10	4.72	5.34	5.95	6.57	7.19	7.79	8.39
10.0	4.90	5.57	6.23	6.88	7.52	8.16	8.78	9.39
11.0	5.72	6.44	7.13	7.82	8.48	9.14	9.77	10.39
12.0	6.56	7.32	8.05	8.76	9.45	10.12	10.76	11.39

*To obtain runoff depths for RCNs and other rainfall amounts not shown in this table, use an arithmetic interpolation

Source: USDA, 1969

(6) $$V_r = \sum_{i=1}^{n} U_r A_d F_6$$

where: V_r = Volume of runoff (liters)

U_r = Unit runoff (inches)

A_d = Area of drainage (acres)

i = Subdivision of drainage area used to determine soil group and RCN

n = Total number of subdivisions

F_6 = 102,802 (converts units to liters).

6) Determine an average daily V_r based upon monthly or annual precipitation and then determine the runoff sedimentation rate by:

(7) $$S_r = \frac{\overline{V}_r \ TSS}{F_7}$$

where: S_r = Runoff sedimentation rate (g/day)

$\overline{V}_r$ = Average daily V_r (l/day)

TSS = Total suspended solids (mg/l). If TSS is unknown, estimate using 227 mg/l.

F_7 = 1000 (converts units to g/day).

This process estimates runoff over various types of physical surfaces. Gain or loss of pollutants from routing of runoff through canals, ditches, swales or gutters has not been specifically addressed. Adjustment for the portion of runoff that does not drain into the marina basin should by considered.

Shoaling Rate

The shoaling rate, and hence the amount of maintenance dredging which may be required, can be determined by:

$$(8) \quad R_s = \frac{\left[S_s + S_r\right] F_8}{\rho_B \ A}$$

where: R_s = Shoaling rate (m/year)
S_s = Suspended load sedimentation rate (g/day; converted from Equation (5)
S_r = Runoff sedimentation rate (g/day)
ρ_B = Bulk density of sediments (g/cm^3)

A = Area of marina basin (m^2)
F_8 = 3.65 x 10^{-4} (converts units to m/year).

Convert S_s from Equation (5) to g/day. If "ρB" is unknown, estimate using 1.5 gm/cm^3 as this would represent a sandy silt type of sediment. This procedure estimates shoaling due to suspended load and runoff within a semi-enclosed marina basin and assumes uniform distribution of sediments throughout the basin. This procedure does not apply to shoaling within entrance channels due to bed load transport.

4.2.3 Dredging and Dredged Material Disposal

Impacts from dredging and construction activities may be environmentally significant, depending upon the physical and biological characteristics of the surrounding water body. The degree of impact depends on the quality of the existing environment; the character of site-specific habitats, wildlife, water quality, adjacent developments; and the manner in which the dredging and disposal is conducted.

Turbidity Increase

Turbidity, which can be both natural and man-induced, refers to the amount of suspended solids in the water column and the corresponding decrease in light transmittance. Stern and Stickle (1978) have defined turbidity as "...an expression of the optical properties of water that cause light to be scattered and absorbed rather than transmitted in a straight line."

Dredging may increase turbidity by resuspending silt or introducing spoil material into the water column (Hirsch et al., 1978). Wave action, erosion of unstabilized dredged canal banks, and leaching of unconsolidated spoil mounds also can increase turbidity (VSWCB, 1979). Agricultural runoff after a rainfall increases turbidity that may be enhanced by currents, tides and wind or manmade effluent flows (Stern and Stickle, 1978).

Natural turbidity may be relatively high due to sediment from rivers (Windom, 1976). Chapman (1968) reports that most of the Gulf of Mexico and south Atlantic estuaries can be characterized as either naturally turbid or comparatively clear. The Mobile Bay area (Chapman, 1968) and the Apalachicola-Cuspate Delta area, along the Florida panhandle (Beccasio et al., 1982), are examples of turbid water zones. The effects of turbidity increases should, therefore, be interpreted in the context of ambient turbidity levels. In areas where turbidity is naturally high, an increase in turbidity from dredging would have less impact. Only 90 meters (300 feet) from a hydraulic dredge discharge pipe, turbidity was diluted to levels occasionally observed in a naturally turbid Louisiana bay (Chapman, 1968). A comparable dredging discharge in a clear water estuary would produce a turbidity plume that would presumably require a much greater dispersion distance before ambient turbidity levels were reached. A dispersion distance of 5 kilometers (3.1 miles) has been reported for the Tampa Bay area (Taylor, 1973).

Elevated turbidity levels can be temporary and localized. Many investigators feel that temporary, localized turbidity increases due to dredging are not significant because estuaries typically experience temporary turbidity increases as a result of tides and because some estuarine organisms, such as fish, can actively avoid these areas. The dredge-related effects of siltation, however, can have a prolonged and serious impact through seagrass destruction, shoaling and circulation changes, and burial of organisms. Open water unconsolidated spoil banks and unstabilized dredged canal banks can be eroded and agitated by wave action and boat prop wash so that turbidity levels remain elevated over long periods. Taylor (1973) relates that fine sediments "are easily resuspended by abnormally strong currents and moderate-to-heavy wave action."

Dissolved Oxygen Reduction

Dissolved oxygen (DO) concentrations near dredging sites have been reported to be lower than concentrations measured away from dredging operations. This may be due to resuspension of bottom sediments that increases turbidity, settleable and suspended solids, and biochemical oxygen demand (BOD; Brown and Clark, 1968). Increased turbidity may reduce the DO content of water surrounding an active dredge by 16 to 83 percent below normal, while increasing the BOD eightfold (Simon and Dyer, 1972 in Johnston, 1981).

High BOD values were present near the surface of Chesapeake Bay 600 feet from a dredge discharge and high BOD values were found near the bottom of Mobile Bay about 1,700 feet from dredging operations (Taylor, 1973). During dredging, the length of time that sediment is exposed to the water column determines the amount of oxygen demand exerted (Windom, 1976). Chmura and Ross (1978) reported that oxygen levels were from 16 to 33 percent below normal during the dredging of a tidal waterway. Conversely, another study reviewed by these authors indicated that measurements for several water quality parameters, including DO and BOD, made before, during, and after dredging of the Atlantic Intracoastal Waterway were not significantly different between dredged and control areas. Sediment studies in Wassaw Sound, Georgia, suggest that the oxygen demand of sediments is capable of removing over 500 times its volume of oxygen from the water column (Frankenberg and Westerfield, 1968). These studies suggest that site-specific measurements, rather than generalizations, often are necessary for assessing effects on dissolved oxygen. DO values at dredge sites are affected by the ambient DO level, circulation, and the amount of oxidizable organic material that is resuspended during dredging (Taylor, 1973). For example, the resuspension of sediment-trapped organics, such as sewage or partially-decayed plant material, would lower dissolved oxygen in the water column more than the resuspension of clean sand.

Dredging canals, particularly dead-end finger (Venetian) canals, can decrease DO in the water column since such canals do not flush well. Anaerobic areas can occur at the base of the canal banks when banks are not sloped to promote flushing. Canal sides cut at essentially right angles to the bottom will have poor flushing potential. Similar anaerobic areas may result if the marina basin or entrance channels are dredged several feet deeper than the nearest existing channel or where stratification of the water column occurs. Anaerobic waters create a sump for pollutants and organics resulting in stagnant, sulfide-odorous and slow decaying (due to low DO) conditions. Dredging of no more than one foot deeper than the nearest channel has been recommended (VSWCB, 1979). Some overdredging, however, may reduce the number of times maintenance dredging is required, which would minimize the frequency of dredging and, therefore, potentially reduce adverse effects.

Maintenance dredging of poorly circulated areas may produce spoil containing malodorous free sulfides. Disposing of such spoil in estuarine sites may have adverse ecological effects on the local flora and fauna not only through siltation, but also in terms of water quality, since free sulfides are toxic to estuarine life (Williamson et al., 1977). Wright (1978) studied the effects of open water disposal offshore of Galveston Bay and determined few effects. Impacts included some increase in manganese and ammonium-nitrogen and the presence of distinct spoil mounds, the finer fractions of which were being eroded. The benthic community did change in abundance but similar changes occurred in control (reference) areas during the time of the study.

Pollutant Resuspension

Pollutants trapped in sediments can be resuspended during dredging (Taylor, 1973; Boozer, 1979; VSWCB, 1979 and others). These include pathogenic bacteria and viruses, heavy metals (mercury, copper, lead, chromium, zinc, arsenic, cadmium, and nickel), hydrocarbons (pesticides), oil and grease, hydrogen sulfide, methane, organic acids, ketones and aldehydes, etc., and nutrients (nitrogen and phosphorus). Although pollutants can be removed from the water column by flocculation, adsorption, and deposition, they can be temporarily available to local pelagic (swimming) organisms and ultimately to benthic (bottom) organisms, particularly those attracted to spoil dump sites for food or colonization (Taylor, 1973). This is of particular concern in areas inhabited by commercial species or the prey of commercial species. Shellfish and other filter feeders concentrate pollutants (Clark, 1974). Therefore, resuspension of sewage bacteria, pathogens, and heavy metals near shellfish could damage the quality of these organisms as a fishery resource.

Results of studies of the release of pollutants associated with dredging activities have been inconsistent. Dredging need not change the concentrations of heavy metals (Williamson et al., 1977; Chmura and Ross, 1978), hydrocarbons (Williamson et al., 1977), or nutrients (phosphate: Chmura and Ross, 1978) in the area. Due to the geochemistry of heavy metals in estuaries, it is not likely that metals would be released during dredging except under unusual conditions (Windom, 1976). After metals accumulate in estuarine sediments, post-depositional changes in sediment pH and oxidation-reduction potential may lead to an increased solubility of some metals. Although this will increase the mobility of metals in sediments, release is unlikely to result. Metal levels typically remain constant after reaching equilibrium with the sediment (Windom, 1976). May (1974) found that metal levels in water samples collected from the effluents of spoil disposal areas did not differ significantly from ambient concentrations in Mobile Bay. Similar results were found in a dredging study of Savannah, Charleston, and Brunswick Harbors (Windom, 1976). However, some studies have shown potentially significant increases (Williamson et al., 1977; Rosenberg, 1977). Rosenberg (1977) reports that benthic fauna in a Swedish estuary exhibited overall increases in mercury, cadmium, zinc, copper, lead and nickel after dredging. Concentrations decreased appreciably one and a half years after dredging was terminated.

Addition of nutrients can be potentially beneficial or detrimental to an estuary. For nutrient-limited estuaries (usually nitrogen limited; Williamson et al., 1977), the resuspension of nutrients, such as nitrogen in the form of ammonia, from sediments may enhance primary productivity (Taylor, 1973). Windom (1976) reported in his dredging study that the concentration of ammonia in the water decreased with time. This may have been due to adsorption on particulate matter, direct uptake by phytoplankton, bacterial nitrification, or straight chemical oxidation. In more nutrient-rich estuaries, nutrient addition could cause eutrophication in the form of algal blooms. Eutrophication could result in the release of algal toxins and a decrease in DO due to algal death and decay.

Initial dredging and periodic maintenance dredging of the marina site will increase the level of suspended solids in the water column and will result in sedimentation of these resuspended particles over a larger area. Mitigative measures for dredging are discussed in Sections 5.4 and 5.5.

Quantity of Suspended Sediments

In order to determine the area of impact for dredging it is necessary to estimate the amount of dredging that would be required initially and for subsequent maintenance. The initial volume of dredging depends upon the specific design of the marina and the pre-construction condition of the site. The volume of maintenance dredging anticipated would depend upon sedimentation at the marina site.

Once determination has been made of the expected volume of dredged material to be removed, the quantity of increased suspended solids can be estimated. The increase in total suspended solids from dredging can be estimated by:

$$(9) \qquad TSS_d = \frac{V_D \, r \, W_d}{V_m}$$

where: TSS_d = Total suspended solids increase due to dredging or construction (mg/l or g/m3)

V_D = Volume of sediment disturbed (dredged or displaced) (m^3)

r = Resuspension factor for sediment type

W_d = Dry weight of sediment (g/m^3)

V_m = Mean volume of marina waters (m^3).

The resuspension factor is the estimated percentage of disturbed sediment volume that is resuspended as a result of the disturbance. In the absence of more definitive information assume r=0.30 for bucket dredging or other disturbance of fine sediments and r=0.10 for hydraulic dredging of fine sediments. For coarse (sandy) sediments assume r=0.10 for bucket dredging and other disturbance and r=0.05 for hydraulic dredging (Carstea et al., 1975). The dry weight of sediment may be estimated as 545 kg/m^3 (Panuzio, 1963).

The assumptions applicable to this method are that the sediments are of relatively uniform consistency and complete mixing within the marina basin takes place.

The National Academy of Sciences, National Academy of Engineering (1973) recommends the following maximum concentrations of suspended sediments for protection of aquatic communities (Carstea et al., 1975):

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• High level of protection	15 mg/l
• Moderate protection	80 mg/l
• Low protection	400 mg/l
• Very low protection	over 400 mg/l

Loosanoff (1965) reported the following relationships between eggs and larvae of oysters and concentrations of suspended material:

Concentration of suspended material (mg/l)	Reduction of eggs survival and development to
250	73%
500	30%
100-2000	about 0%

A concentration of 750 mg/l of suspended sediment had adverse effects on growth of oyster larvae. The larvae of oysters experienced virtually no growth when the sediment reached concentrations of 1,500 mg/l.

Sedimentation Within Marina Basins

One assumption used for the earlier determination of sedimentation from suspended load (Equation 5) was that the semi-enclosed marina had about 100 percent trapping efficiency. If this was the case, sediments resuspended from dredging in such a marina would resettle within the marina basin and the net effect would be a redistribution of sediments throughout the basin. The increase in shoaling from this redistribution can be estimated as follows:

$$(10) \qquad S = \frac{V_m \ TSS_d}{\rho_B \ A} \times F_{10}$$

where: S = Shoaling as a result of redistribution (m)
All other parameters as defined previously in Equations (8) and (9)

$F_{10} = 1 \times 10^6$ (converts units to m).

Sedimentation In Adjacent Areas

The result from Equation (10) can be used to determine the depth of benthic blanketing as a result of dredging within the marina basin. Deposition of silt and clay accumulating to 27 cm (10.5 inches) was reported at a distance of 0.8 km (0.5 mi) from a spoil disposal site in Tampa Bay (Taylor, 1973). Chapman (1968) reported that silt was deposited as far as 396 m (1,300 ft) from a dredge operating in a shallow bay in Louisiana and approximately 274 m (900 ft) from a hydraulic shell dredge in a Texas bay. Sediment depositions from a hydraulic dredge working to construct the Gulf Intracoastal Waterway accumulated to 22 cm

(8.7 inches) in one week and 33 cm (13.0 inches) in 18 months (Chapman, 1968).

The effects of turbidity and siltation on adjacent areas can be strongly influenced by prevailing tides and by the direction and velocity of currents. A change in tidal cycle can reverse the direction of a turbidity plume, resulting in expansion of the area of impact but reduction in the degree of impact.

Small-diameter particles such as silt and clay typically settle slowly. Marine waters have a high electrolyte content which neutralizes surface charges on small particles. This causes fine particles to aggregate into larger particles that settle faster (Windom, 1976). Settling rates in estuaries and the open ocean would be increased by agglomeration and flocculation processes (Stern and Stickle, 1978), but would be decreased by the presence of currents and possibly salinity and temperature gradients.

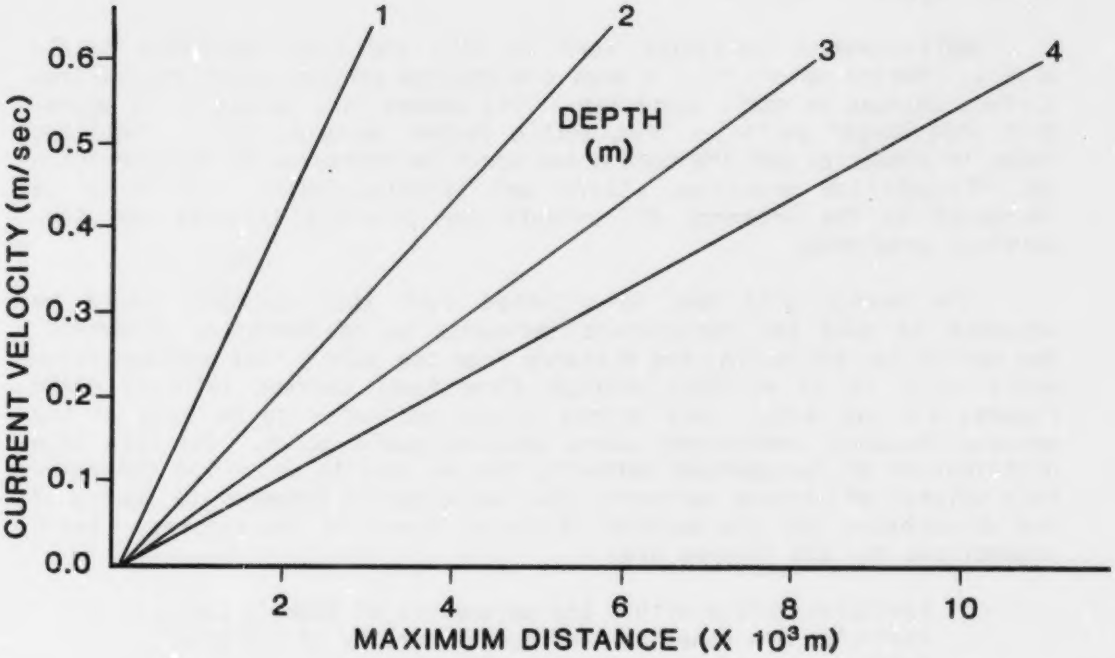
The marina site may be situated such that currents would be expected to move the resuspended sediments to be deposited elsewhere. One method for estimating the distance from the source that sedimentation would occur is to estimate average directional current velocity using Figures 4-4 and 4-5. This method allows estimates to be made of the maximum distance downcurrent where settling would occur. Particle size distribution of resuspended sediments can be used to determine the relative volumes of various sediments that would settle between the source of the disturbance and the maximum distances shown in the figures. Basic assumptions for the figures are:

- Particles settle within the parameters of Stoke's Law
- Particles are spherical and have a density of 2.0 g/cm^3
- Settling is under quiescent conditions
- Fluid density is uniform.

The potential for flocculation and subsequent faster settling rate is not considered. Therefore, a greater amount of settling of resuspended sediments may occur nearer to the disturbance source than would be indicated by the figures. Measures to reduce the impacts from siltation are discussed in Section 5.4.

4.2.4. Shoreline and Protective Structures

Marinas use shoreline and protective structures to retain their developed shores, to protect against waves generated by wind and moving watercraft, and to provide public access to navigable water. Several authors have reviewed marina structures including Bara, et al. (1977), Chmura and Ross (1978) and Mulvihill et al. (1980). The latter review is a complete summary of the impacts from minor shoreline structures with numerous references.



FINE SAND: Particle diameter = 2 X 10^{-2}mm
Settling velocity = 2.2 X 10^{-2}cm/sec

Figure 4-4. Approximate settling distance for spherical particle with density of 2.0 g/cm^3 and diameter of 2 X 10^{-2}mm, (Mysels, 1959).

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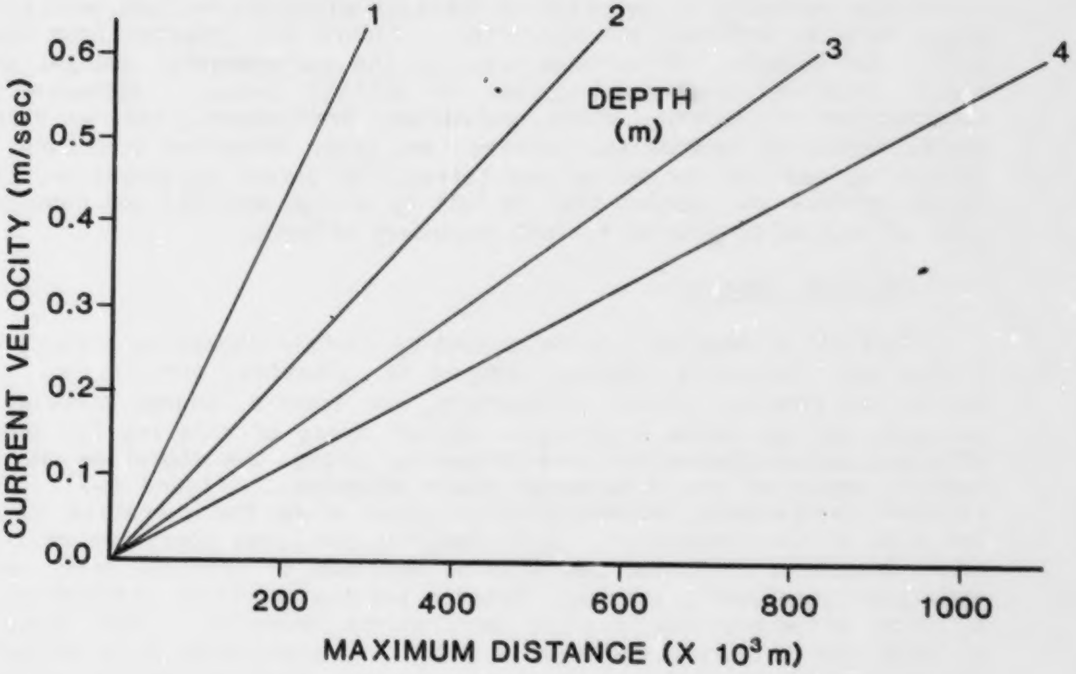

SILT: Particle diameter = 2 X 10^{-3}mm
Settling velocity = 2.2 X 10^{-4}cm/sec

Figure 4-5. Approximate settling distance for spherical particle with density of 2.0 g/cm^3 and diameter of 2 X 10^{-3}mm, (Mysels, 1959).

The shoreline and protective structures relevant to marinas include:

- Piers and piles
- Jetties, groins, and breakwaters
- Bulkheads, revetments, and ramps.

Development of marinas usually involves dredging and construction of shoreline structures, access roads, and shop and supply buildings. These operations typically alter existing habitats which may include productive areas such as wetlands and estuaries. Figure 4-6 (adapted from Odum, 1971), for example, illustrates some of the environmental changes that result from bulkhead construction in wetland areas. Although the construction of pilings, docks, bulkheads, breakwaters, rip-rap revetments, vegetated revetments, jetties, and other shoreline structures do afford new habitat for marine and terrestrial animal colonization, they do not replace the habitat that is lost by dredge and fill and construction activities or altered through secondary effects.

Physical Impacts

Physical alteration can be caused by certain shoreline structures. Alterations frequently involve changes in siltation, circulation, turbidity and erosion. Solid breakwaters, for example, change circulation patterns and may cause shoaling. Typical areas of shoaling for shore-attached solid breakwaters are primarily along the shoreline at the updrift angle of the breakwater shore attachment (Figure 4-7). For detached breakwaters, accumulation is often along the shoreline on the lee side of the breakwater. Such shoaling can cause downshore erosion. Areas downshore of groins may also be deprived of littoral drift sediments and consequently scoured. Erosion and the resulting sediment accumulation elsewhere may require maintenance dredging. For example, although the primary purpose of a jetty is maintenance of a navigable channel depth, the inlet channel may require dredging due to sediment accumulation. Dredging around other structures, such as solid breakwaters, may also be necessary.

The volume of sediment disturbed for structure emplacement can be estimated from Table 4-6 and the quantity of resultant suspended sediments can be estimated using Equation (9). Resultant shoaling within the marina basin and sedimentation in adjacent areas can be estimated by Equation (10) and Figures 4-4 and 4-5 as described in Section 4.2.3

Other physical changes are related to alteration of tidal, current, or wave patterns. The presence of shoreline structures can produce secondary waves that reflect off the structure. Breakwaters (Figure 4-8) can reflect waves produced by boats traveling on the protected lee side between the breakwater and the shore. Vertical bulkheads (Figure 4-9) can reflect waves that cause erosion of the foreshore, since the energy of incoming waves is often not adequately dissipated by the bulkhead facing. Erosion of adjacent areas may also occur until a new geohydraulic equilibrium is reached. The base (toe) of the bulkhead may

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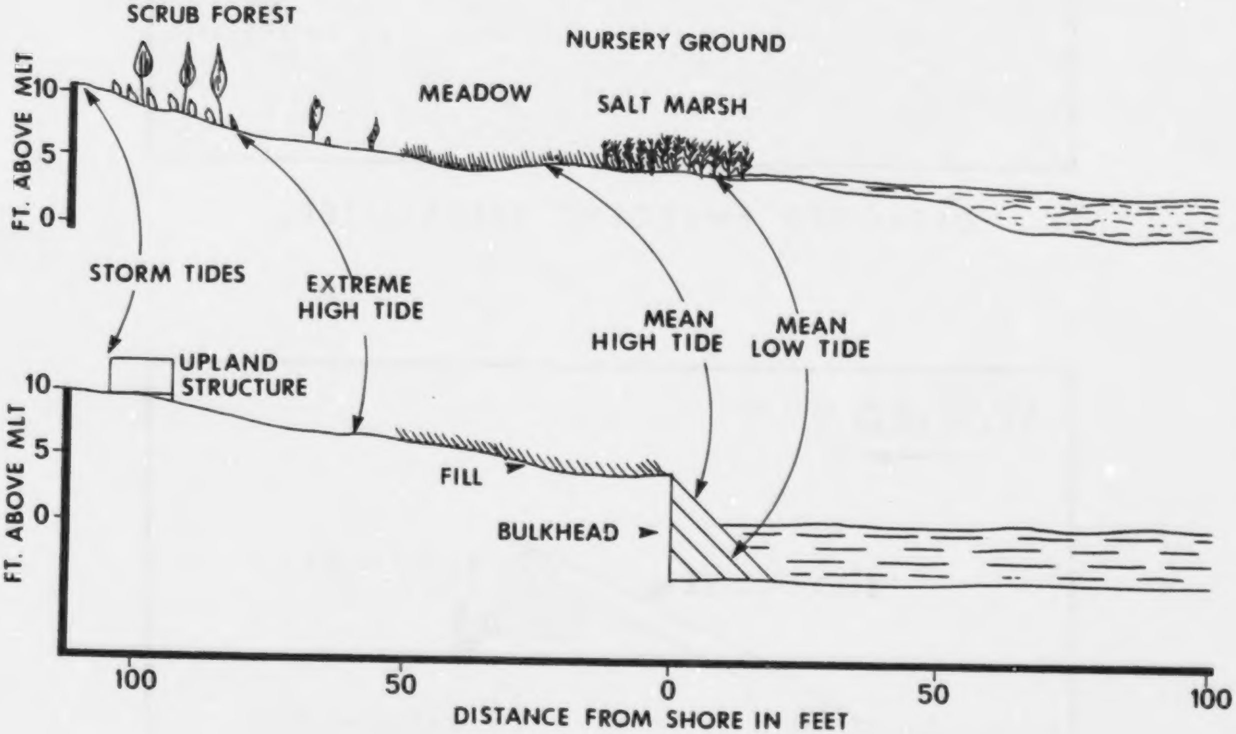
SCRUB FOREST
NURSERY GROUND
MEADOW
SALT MARSH
FT. ABOVE MLT
10
5
0
STORM TIDES
EXTREME HIGH TIDE
MEAN HIGH TIDE
MEAN LOW TIDE
UPLAND STRUCTURE
FT. ABOVE MLT
10
5
0
FILL
BULKHEAD
100
50
0
50
100
DISTANCE FROM SHORE IN FEET

Figure 4-6. A profile of a shoreline wetland area comparing a natural productive environment (top) with an altered condition (bottom) following bulkhead construction (adapted from Odum, 1971).

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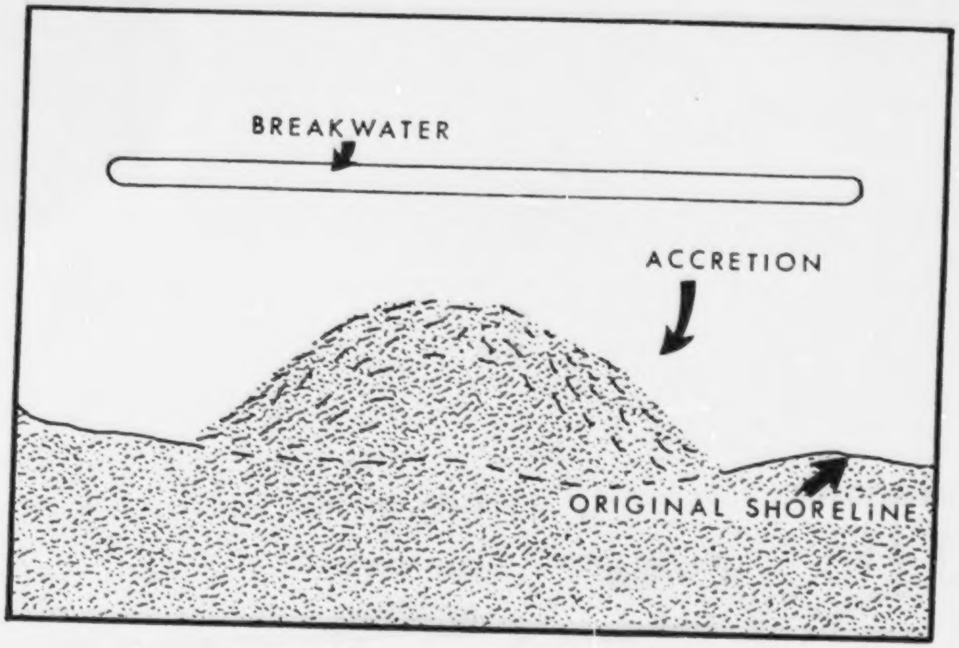
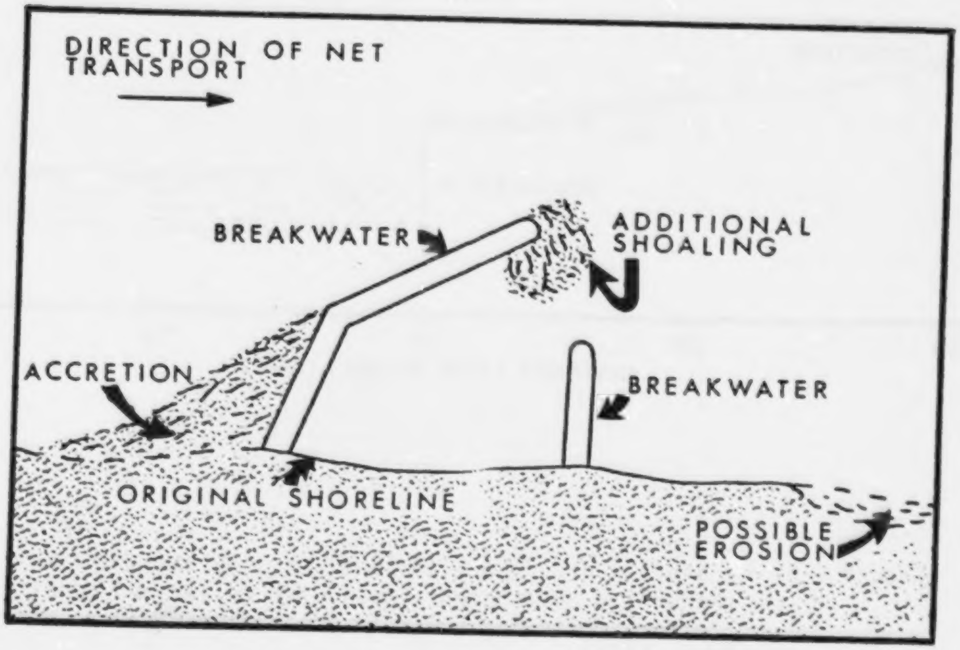

BREAKWATER
ACCRETION
ORIGINAL SHORELINE

DETACHED EMERGENT BREAKWATER


DIRECTION OF NET TRANSPORT
BREAKWATER
ADDITIONAL SHOALING
ACCRETION
BREAKWATER
ORIGINAL SHORELINE
POSSIBLE EROSION

ATTACHED BREAKWATER

Figure 4-7. Shoaling associated with detached and shore-attached solid breakwaters (Source: excerpted from Mulvihill, et al., 1980).

TABLE 4-6

CHARACTERISTICS FOR ESTIMATING AMOUNT OF SEDIMENT DISTURBED BY STRUCTURE EMPLACEMENT

Structure Type	Length (m)	Average width (m)	Depth in Sediment(m)	Comments
Riprap	AR	1.5	0.15	
Bulkhead	AR	0.3	0.6	$0.6m^3$ disturbed for each pile and for sheeting
Groins	AR	1.5	0.3	
Piers	AR	NA	NA	For about every 2m of pier length estimate 0.1 m^3 of disturbed sediment

AS = As required
NA = Not applicable

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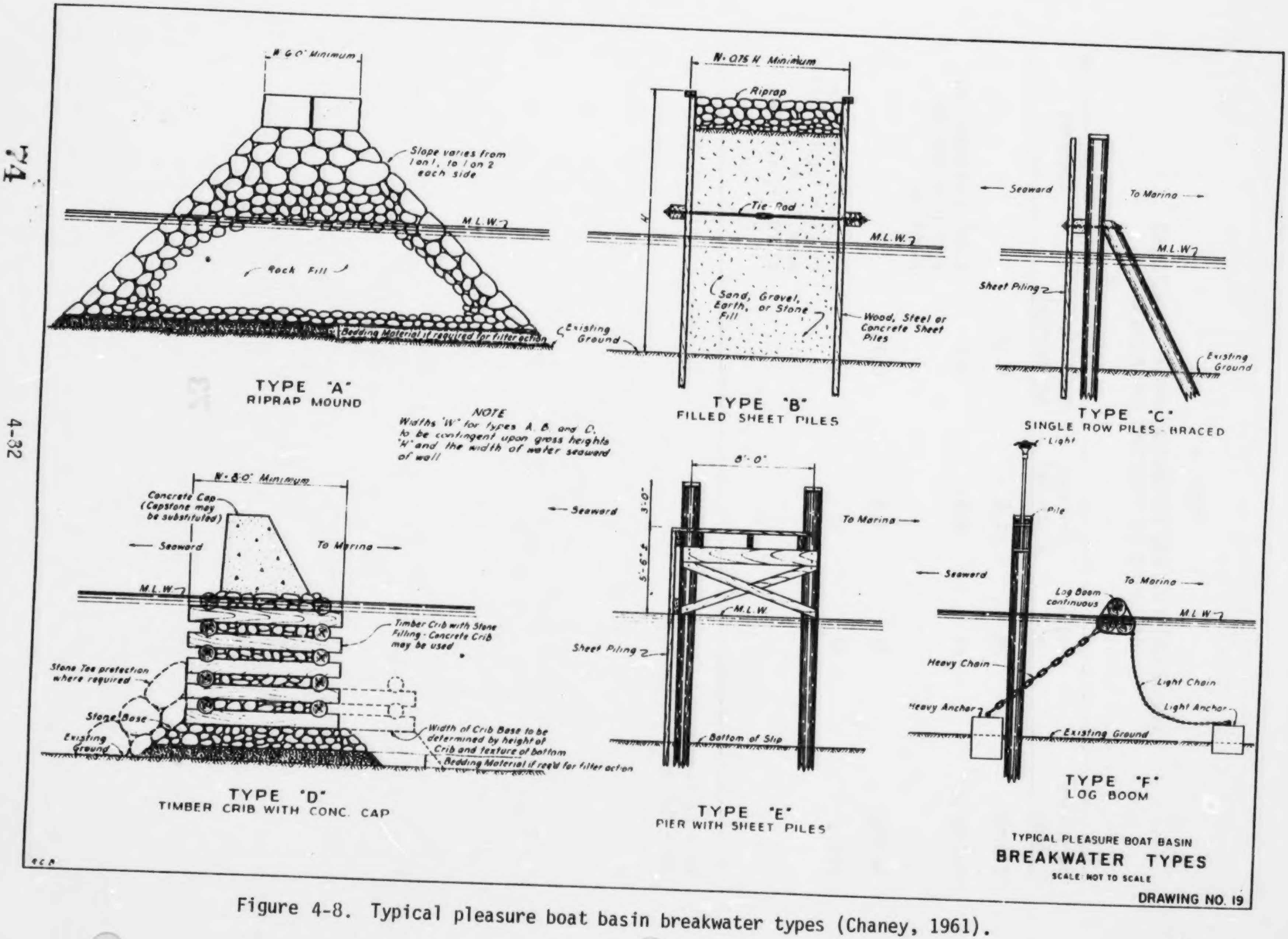
W-6.0' Minimum
Slope varies from 1 on 1, to 1 on 2 each side
M.L.W.
Rock Fill
Existing Ground
Bedding Material if required for filter action
TYPE "A"
RIPRAP MOUND
W-0.75 H Minimum
Riprap
H
Tie-Rod
M.L.W.
Sand, Gravel, Earth, or Stone Fill
Wood, Steel or Concrete Sheet Piles
Existing Ground
TYPE "B"
FILLED SHEET PILES
Seaward
To Marina
M.L.W.
Sheet Piling
Existing Ground
TYPE "C"
SINGLE ROW PILES - BRACED
NOTE
Widths 'W' for types A, B, and C, to be contingent upon gross heights 'H' and the width of water seaward of wall
W-8.0' Minimum
Concrete Cap (Capstone may be substituted)
Seaward
To Marina
M.L.W.
Timber Crib with Stone Filling - Concrete Crib may be used
Stone Toe protection where required
Stone Base
Existing Ground
Width of Crib Base to be determined by height of Crib and texture of bottom
Bedding Material if req'd for filter action
TYPE "D"
TIMBER CRIB WITH CONC. CAP
8'-0"
3'-0"
5'-6"
Seaward
To Marina
M.L.W.
Sheet Piling
Bottom of Slip
TYPE "E"
PIER WITH SHEET PILES
Light
Pile
Seaward
To Marina
Log Boom continuous
M.L.W.
Heavy Chain
Light Chain
Heavy Anchor
Light Anchor
Existing Ground
TYPE "F"
LOG BOOM
TYPICAL PLEASURE BOAT BASIN
BREAKWATER TYPES
SCALE: NOT TO SCALE
DRAWING NO. 19
R.C.R.

Figure 4-8. Typical pleasure boat basin breakwater types (Chaney, 1961).

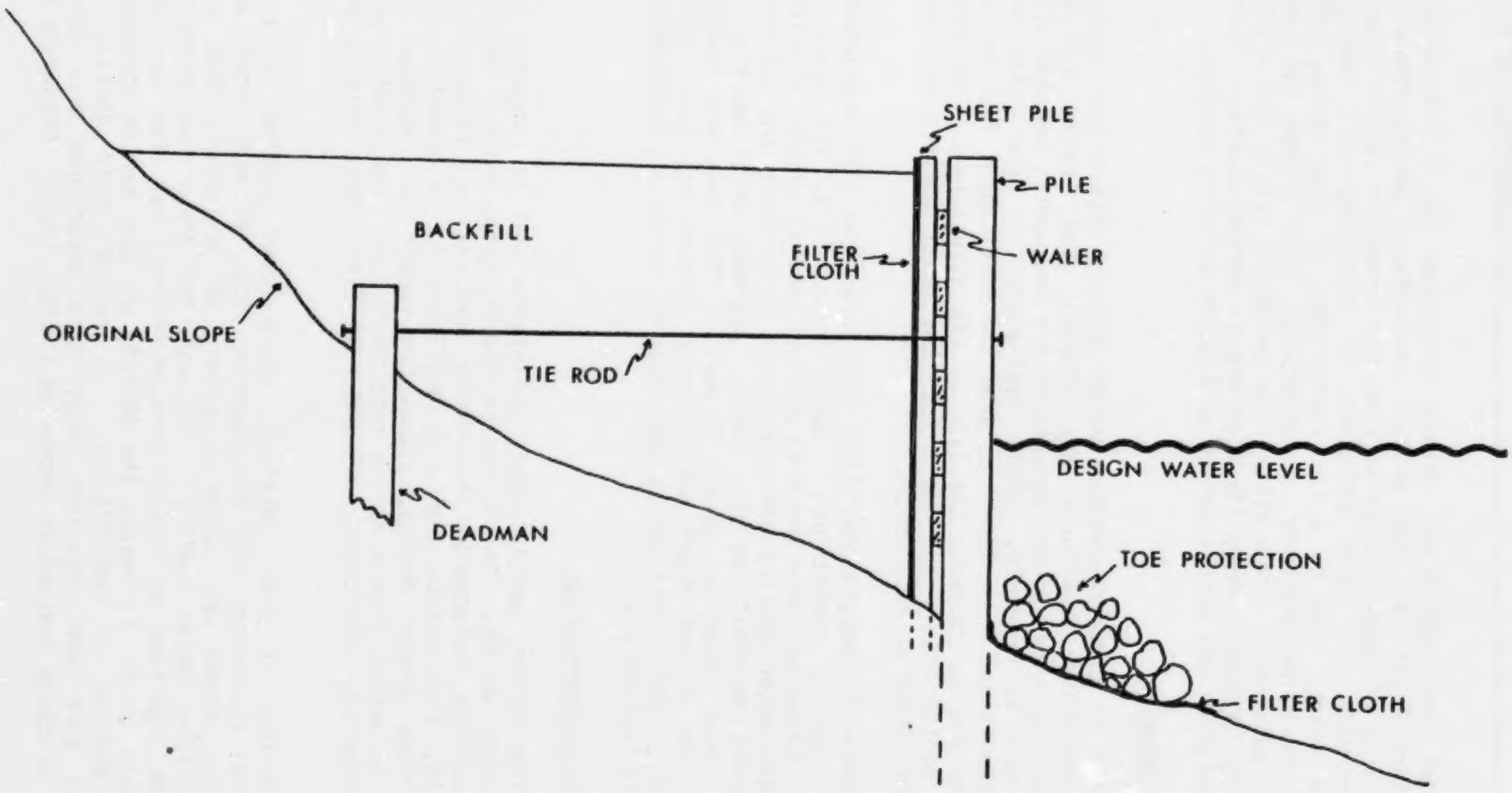
SHEET PILE
PILE
BACKFILL
FILTER CLOTH
WALER
ORIGINAL SLOPE
TIE ROD
DESIGN WATER LEVEL
DEADMAN
TOE PROTECTION
FILTER CLOTH

Figure 4-9. Side view of a typical sheet pile bulkhead. Dimensions and details to be determined by particular site conditions. (Mulvihill et.al., 1980)

also be scoured and undermined unless protected by a revetment. Revetments (Figure 4-10) can also produce reflectance waves, however, these are generally of lower energy because the irregular and/or sloped facing of revetments are more efficient in absorbing wave energy. Altering a high energy area to a low energy one, or vice versa, subsequent to the shoreline placement of structures, will change the composition of the substrate, since silty fine sediments typify low energy areas and coarser sediments exemplify high energy bottom habitat. These changes in circulation and sedimentation will alter existing habitat.

Chemical Impacts

In addition to dredging-related water quality alterations during construction, shoreline structures may produce other water quality changes. Pilings and other wooden structures are frequently treated with preservatives such as creosote, copper napthenate, or other zinc and copper salts (Chmura and Ross, 1978) to slow the settling of fouling and boring organisms and to increase the life of the structures. Chemicals do leach into marina waters and can affect the water quality and non-target organisms (Nixon et al., 1973).

The presence of certain shoreline structures can also exacerbate degraded water quality conditions. Solid breakwaters, for example, reduce the wave action on their lee side and can inhibit natural flushing so that decreased water quality and changes in temperature and salinity regimes may result (Mulvihill et al., 1980). Degraded water quality can also occur in finger (Venetian) canals in marinas that have been dredged and bulkheaded and do not flush sufficiently (Chmura and Ross, 1978; Mulvihill et al., 1980). Mitigative measures for structure emplacement are discussed in Section 5.4

4.2.5 Pollutant Concentration

Runoff from marinas may introduce pollutants that can degrade the quality of adjacent waters. During marina construction, natural vegetative cover is usually replaced by impermeable surfaces such as buildings or parking lots, that reduce the area available for stormwater percolation. Without proper design, stormwater runoff can increase and pollutants may be washed from a marina into the water. These pollutants may include sediments, pesticides, oil and road dirt, heavy metals, and nutrients.

During periods of heavy rainfall, storm sewer systems designed simply to channel stormwater away from parking lots, walkways, roofs and other collection points may carry a variety of pollutants that are capable of degrading water quality. Not only may these substances be toxic to marine organisms at certain concentrations, but they may have sublethal effects which 1) reduce the ability of some marine organisms to survive predation or competition; 2) reduce their ability to reproduce; 3) give some organisms competitive advantages over other organisms; or 4) cause anatomical anomalies (Smith, 1981). Organisms in

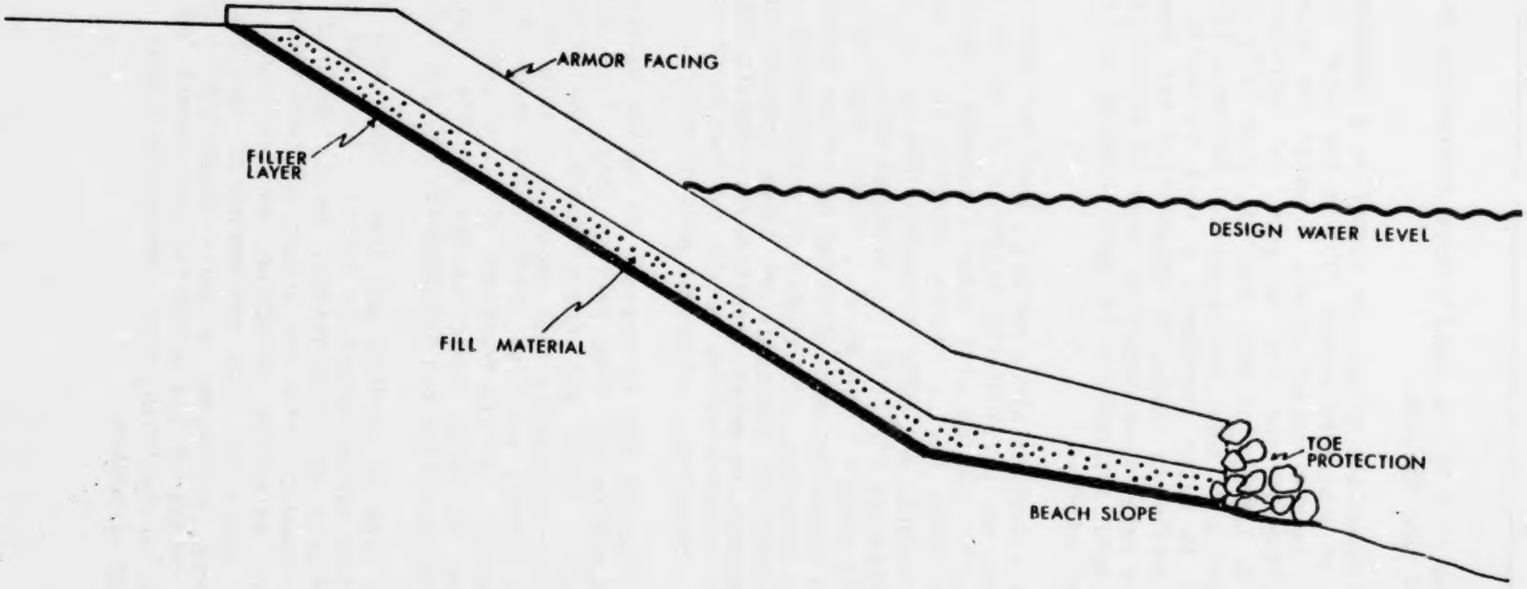
ARMOR FACING
FILTER LAYER
DESIGN WATER LEVEL
FILL MATERIAL
TOE PROTECTION
BEACH SLOPE

Figure 4-10. Profile of a revetment. Construction materials, dimensions and details are determined by particular site conditions. (Mulvihill et.al., 1980)

the earlier stages of life are usually more susceptible to pollution than are adults of the same species.

One of the immediate effects of runoff is a temporary reduction in the availability of dissolved oxygen (DO) in the water (Soule and Oquri, 1977). Normally, oxygen concentrations in water are between 5.3 and 8.0 ppm which is sufficient for fish to grow and reproduce. Lower concentrations can be lethal for most species, especially if DO is reduced to 1.25 ppm within a 24 hour period (United Nations, 1982a). Reduction of the DO level in water represents a risk to marine life and could trigger severe shifts in community composition and abundance. Waters with low exchange rates have naturally lower DO concentrations and, consequently, are more susceptible to deoxygenating pollutants than are rapidly exchanged waters.

Heavy metals such as zinc, mercury, lead and cadmium in their pure state usually are not particularly hazardous to marine life. However, these metals easily combine with other compounds, particularly organic ones, to become quite toxic. Every organism has a certain tolerance level for heavy metals, and metal concentrations as low as 0.5 ppb may be toxic to some organisms (Table 4-7). Although metals can settle out very rapidly in marina waters (Chen et al., 1972), they may be redistributed in the marina by propeller wash stirring up bottom sediments. Shellfish and other marine organisms are capable of concentrating dissolved metals by factors hundreds or thousands of times greater than that of the concentration present in water (Table 4-7). Metals such as copper are frequently found in anti-fouling paints applied to or scraped off boats at a marina and, therefore, can become part of runoff.

Petroleum products may be present in marine waters as a result of runoff from automobile oil from parking lots, fuel spills and perhaps bilge drainings. USEPA and Coast Guard regulations prohibit the discharge of oil or oily waste that causes a visible film or sheen on the water's surface (Chmura and Ross, 1978). The regulations are difficult to enforce, however. Certain fractions of oil or petroleum products have been established as being toxic to marine life (Table 4-8) and are discussed in Boat Operation and Maintenance, Section 4.2.6.

Pesticides used at marinas and their associated developments also may be washed into marina waters by runoff. Much has been written about the harmful effects of insecticides, herbicides and fungicides, particularly the organo-chlorine and organophosphate compounds such as DDT, dieldrin, endrin, malathion, parathion, and fenthion. Few data exist on newer kinds of pesticides like carbamates or juvenile hormone analogs. In many instances, pesticides or their decomposition products enter the biogeochemical cycles of the estuarine environment and are toxic to or are accumulated by shellfish, fish, shrimp and crabs. These animals may then be consumed by humans.

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TABLE 4-7

TOXICITY AND BIOACCUMULATION CONCENTRATION FACTORS OF HEAVY METALS IN MARINE ORGANISMS[a]

Metal	Toxicity (ppb)		Bioaccumulation concentration factor[b]		Remarks
Zinc	fish crustaceans algae minimal risk	30 – 90 14 – 200 0.5 – 5 20	fish oysters phytoplankton zooplankton	1,600 – 2,100 150,000 – 290,000 113 1,000	Emetic dose for man is 675 ppm
Copper	fish crustaceans	4.5 – 6.5 0.33 – 29.5	fish oysters phytoplankton zooplankton	130 – 660 24,000 – 35,000 38 437	Emetic dose for man is 500 ppm
Nickel	fish crustaceans oysters (embryo)	0.8 – 125 100 – 300 1.19	fish oysters phytoplankton zooplankton	125 100 41 149	Lethal oral dose is 1g/kg body weight
Chromium	fish crustaceans oysters (embyro)	33 – 100 200 10.3	fish oyster phytoplankton zooplankton	200 500 34 65	Drinking water standard 0.05 ppm
Lead	fish	0.34–188	fish oysters phytoplankton zooplankton	6,000 – 10,000 7,000-100,000 2,087 15,500	Continuous ingestion of shellfish from highly contaminated areas is a human health hazard
Arsenic	fish oyster (embryo) worms	8.4 7.5 25	fish oyster	77 – 100 432 – 810	Arsenic concentrations are not magnified by food chains.
Antimony			oyster fish	300 100	
Molybdenum	algae	54	fish oyster phytoplankton zooplankton	100 100 10 20	
	algae	2	fish oyster	10,000 10,000	
Vanadium	algae	10 – 20	fish oyster phytoplankton zooplankton	10 200 100 200	Fatal dose for humans is 120 ppm
Cobalt	algae	0.5	fish phytoplankton zooplankton molluscs crustaceans	500 190 365 1,000 – 5,000 1,000 – 5,000	Lethal dose for rabbits is 700 mg/kg body weight.
Silver	algae fish molluscs	0.05 0.01 – 0.04 0.0006	phytoplankton zooplankton fish molluscs	98 117 100 200	

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[a] United Nations, 1982a.

[b] Bioaccumulation concentration factor is the number which indicates the concentrative effectiveness of the type or organisms named; i.e., if the concentration of a metal in water is 3 ppb and the organism has a concentration factor of 200, then it is possible for that organism to have 600 ppb concentration of that metal in its tissues.

TABLE 4-8

ESTIMATED CONCENTRATION OF SOLUBLE AROMATIC FRACTIONS OF OIL WHICH ARE TOXIC TO MARINE ORGANISMS[a]

Class of organisms	Toxic concentration (ppm)
Flora	10-100
Finfish	5-50
Larvae (all species)	0.1-1.0
Swimming crustaceans	1-10
Snails	1-100
Bivalves	5-50
Bottom-dwelling crustaceans	1-10
Other bottom-dwelling organisms (worms, etc.)	1-10

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[a] United Nations, 1982a.

Pesticides are used to eliminate noxious or harmful insects and, consequently, these chemicals are usually harmful to non-target species, particularly crustaceans which are related to insects (Table 4-9). Elimination of non-target species has led to the banning of some pesticides, such as DDT and mirex, in recent years. The sublethal effects of pesticides include elevation of metabolic levels, prevention of maturation or molting, reduced ability to osmoregulate, reduced ability to endure temperature and salinity changes, and lethargic behavior (Hart and Fuller, 1979). All of these sublethal effects reduce the ability to avoid predation. Pesticides are generally insoluble in water but are readily adsorbed on particulate matter. Uptake of pesticides by estuarine organisms may take place by injestion of particulate matter, from water passing over the gills or by diffusion through the skin or exoskeleton (Hart and Fuller, 1979). The amount of pesticide and herbicide use associated with marinas has not been quantified. Studies performed by USEPA (1975b) of finger-fill canals in the Southeast showed no significant pesticide accumulation in the sediments.

Other potentially harmful runoff products include sediments, detergents and excessive nutrients. Sediment runoff leads to increased turbidity, the effects of which were previously discussed. Detergents, including oil dispersants, are discussed in Boat Operation and Maintenance (Section 4.2.6). One result of nutrient or organic enrichment is to increase the productivity of the benthos (Hart and Fuller, 1979) or seagrass beds (Zieman, 1982). With the continued input of excessive nutrients, however, the number of species and individuals present will be reduced. A zone of reduced productivity is then created near the source of excessive organic enrichment. This zone will grow larger as input is continued, and the areas closest to the input source may become devoid of life. This reduces the amount of dissolved oxygen available for biotic respiration, stimulates algal blooms that can further reduce the supply of dissolved oxygen, changes the texture of bottom substrates which may make an area unsuitable for some species and stimulates the growth of nuisance plants.

Sanitary pollutants can enter marina waters in wastewater directly discharged as untreated or macerated fecal waste from marine sanitation devices (MSDs) aboard boats or from improper functioning or poorly located septic systems that allow sewage effluents to leach into marina waters. Both of these wastewater sources cause an increase in the nutrient supply of adjacent waters as well as an increase in chemical oxygen demand. In addition, local shellfish beds may be affected by the introduction of disease-causing viral or bacterial organisms (pathogens) found in sewage. Oysters and other bivalves concentrate enteric bacteria and viruses from the surrounding water as they feed.

TABLE 4-9

LETHAL CONCENTRATIONS OF PESTICIDES IN SELECTED MARINE CRUSTACEANS[a]

Group of organisms	Pesticide	Lethal concentration (ppb)
Commercial shrimp	Chlordane	0.4
	DDT	0.1
	Dieldrin	0.9
	Endrin	0.28
	Heptachlor	0.11
	Hexachlorobenzene	25.0
	Lindane	0.17
	Mirex	1.0
	Toxaphene	1.4
Crab larvae	Sevin	10.0
	Malathion	17.0 (mud crabs)
	Malathion	50.0 (blue crabs)
	DDT	0.5

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[a] Hart and Fuller, 1979.

Large quantities of raw or improperly treated sewage from inadequate or overloaded treatment facilities, seepage from septic tanks and excessive stormwater runoff enter southeastern estuaries every day. Marinas and boating activities contribute a relatively small amount to the total pollutant loads into the waterways compared to other sources. It is the location of marinas near sensitive areas that increases the significance of their impact (Ervin et al., 1980). The effect of sewage on estuarine organisms is dependent upon many factors, such as the amount and degree of treatment, the location, and the depth, as well as the particular hydrographic conditions at the point of discharge. Because of these varying factors, each discharge is relatively unique and should be considered separately. Some generalities may be made, however. Small quantities of sewage may be discharged into adjacent waters provided that water circulation patterns are adequate for dispersal. In such cases, sewage discharge will have little or no impact on the environment and may even enhance the bottom-dwelling community in terms of numbers of species and biomass (Zieman, 1982; Hart and Fuller, 1979). However, a given locality can assimilate only so much organic matter before the biota begins to deteriorate (Hart and Fuller, 1979).

Surface runoff may contribute significantly to water quality degradation at marina sites. Surface runoff accounted for the majority of the contamination during periods of moderate to heavy rainfall at Surf City, North Carolina (Shiver and Register, 1978; USEPA, 1975b). Surface runoff also was reported to be a major factor in the closing of shellfish waters in the vicinity of Hilton Head, South Carolina (USEPA, 1983). Shiver and Register (1978) and USEPA (1975b) concluded from studies of total and fecal coliform contamination originating from septic tanks on finger-fill canals at Surf City, North Carolina that total coliform bacteria and other pollutants were transported into shellfish waters indirectly by runoff during periods of significant rainfall and directly through groundwater. Direct transport accounted for less than 3 MPN/100 ml for both total and fecal coliform, and indirect transport or surface runoff of contaminated waters resulted in total coliform ranging from 22,100 to 240,000 MPN/100 ml and fecal coliform from 330 to 13,000 MPN/100 ml in shellfish waters immediately adjacent to the runoff. Therefore, it was concluded in these studies that conventional septic tanks appeared to adequately filter out bacteria from the septic tank leachate under normal conditions.

Expected pollutant concentrations in marina basins and adjacent waters can be estimated by evaluating the type and quantity of pollutant loadings expected and the dilution and transfer of such pollutants by various flushing mechanisms. For semi-enclosed marinas an appropriate estimate can be made by using a dilution formula for a conservative or non-conservative pollutant. Pollutant concentrations for marinas located on rivers, bays or estuaries also may be estimated by dilution type solutions, but a better estimate may require a more complex dispersion type solution such as that discussed later in this section.

In order to assess the water quality impacts of marina-derived pollutants on the environment using the methods discussed in this section, certain pollutant loading values must be available for use. If actual values for various loadings are not available, estimations can be made using Tables 4-10 and 4-11. Assumptions for Table 4-11 are outlined in Carstea et al. (1975) and summarized as follows:

- Average persons per boat is three
- Average per capita discharges of coliform bacteria and BOD are 2 billion and 75.6 g respectively
- Half of the people on board contribute fecal material in 24-hours
- Coliform bacteria populations do not increase
- A boat in use spends one hour in the marina
- 25 to 40 percent of boats present are in use and evenly distributed
- An average boat has a 2-cycle 30 hp outboard motor, consumes 4.458 liters of gasoline per hour, operates at 1000 rpm and the fuel consists of 50:1 gasoline to oil
- Density of waste fuels is 0.7 g/ml.

Mitigative measures to reduce impacts from marina and boat-derived pollutants are discussed in Sections 5.4 and 5.5.

Dilution Methods

Semi-Enclosed Marinas

Estimates can be made of pollutant concentrations for a non-continuous addition of pollutant in a semi-enclosed marina basin. In the following equation, an input of a pollutant over a short period of time, is treated as if it were discharged all at once.

$$C_t = \left(\frac{AL + bAR - IT_C}{AH}\right)^N \left(\frac{M}{F_{11}V_L}\right) \exp(-kt) + CA \exp(-kt) \qquad (11)$$

where: C_t = Concentration of pollutant at time t (mg/l)

C_A = Ambient concentration of pollutant prior to addition of discharge (mg/l)

M = Mass of pollutant discharged into basin (mg)

TABLE 4-10

REPRESENTATIVE CONSTITUENT CONCENTRATIONS FOR URBAN RUNOFF

Parameter	Concentration (mg/l)
Suspended solids	227
BOD	17
Nitrogen	3.1
PO_4 (hydrolyzable)	1.1

Source: Carstea et al., 1975

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TABLE 4-11

ESTIMATED POLLUTANT CONTRIBUTION FROM BOATS

Boats Total	Boats in Use	BOD (g/hr)	Coliform Bacteria (billions/hr)	Non-Volatile Oil (g/hr)	Volatile Oil (g/hr)	Phenol (g/hr)	Lead (g/hr)
1	1	4.54	0.13	66.7	37.8	0.8	0.4
5	2	9.08	0.25	133.5	75.6	1.6	0.8
10	3	13.62	0.38	200.1	113.4	2.4	1.2
20	5	22.70	0.63	333.5	189.0	4.0	2.0

Source: Carstea et al., 1975

k = Decay rate for non-conservative pollutants (day^{-1})

t = Time (days)

N = Number of tidal cycles ($24t/T_c$)

F_{11} = 1000 (converts units to mg/l).

All other parameters as previously defined in Equations (1) and (3).

Representative values for k are provided in Table 4-12.

This formulation includes all of the assumptions presented for Equation (1). In addition it is assumed that the pollutants remain in solution and loss to the marina sediments is minimal. The result of these assumptions is that concentrations obtained would probably exceed actual concentrations measured. It is also assumed that the pollutant decay is first order. Values for k are critical for accurate estimates. Therefore, the k values in Table 4-12 should be used only if actual values cannot be obtained for the site under consideration. These values are generally determined empirically and are specific to a temperature of 20°C and the set of physical conditions existing at the time of measurement.

For a continuous discharge of pollutant into the marina basin, a conservative estimate of long-term concentrations may be obtained by:

$$C = \left[\frac{M_r T_f \, (F_{12})}{V_m} \right] + C_A \tag{12}$$

where: C = Concentration of pollutant (mg/l)

M_r = Mass flow rate of pollutant into basin (mg/day)

All other parameters as defined previously in Equations (3) and (11)

$F_{12} = 4.17 \times 10^{-5}$ (converts units to mg/l).

This method will give estimated concentrations that are much higher than actual concentrations because buildup of pollutant through the entire residence time is assumed. If results using Equation (12) indicate excessive levels of pollutants, a closer approximation may be obtained by the following:

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TABLE 4-12

REPRESENTATIVE REACTION COEFFICIENTS

Pollutant	Typical k Value (day -1)*
BOD	0.25
Total Nitrogen	0.1
Total Phosphorus	0.12
Coliform	1.2

*k = decay rate for non-conservative pollutants.

SOURCE: USEPA, 1978

(13)

$$C = \sum_{t=1}^{j} \left[\left[\left(\frac{AL + bAR - IT_c}{AH} \right)^{\frac{24t}{T_c}} \left(\frac{M}{F_{11} V_L} \right) \exp(-kt) \right] + C_A \exp(-kt) \right]$$

where: $j = T_f/24$

M = Mass of pollutant discharged in one day (mg)

All other parameters as defined in Equations (1) and (11)

F_{11} = 1000 (converts units to mg/l).

Equation (13) approximates the continuous dilution of a pollutant discharged into the marina basin resulting in a lower cumulative concentration over the flushing time than would be estimated using Equation (12). Therefore, if Equation (12) produces results that are acceptable, such as an indication that the pollutant concentration will be low, the more complex Equation (13) will be avoided.

Dissolved Oxygen

The discharge of pollutants to the marina basin may impose a biochemical oxygen demand that can be combined with estimated sediment oxygen demand to provide an estimate of oxygen depletion in the basin. This estimate requires a variety of assumptions. The approach to dissolved oxygen (DO) considerations is to conduct a DO mass balance over one tidal cycle and determine whether significant DO reduction occurs. If it does, this would represent a point of concern for planning purposes. The equation to use is as follows:

(14)

$$DO_R = \frac{DO_A V_P 10^3 + (DO_S - DO_A) V_P F_{14} \exp\left(\frac{-k_1 T_c}{24}\right) - \frac{C_B T_c}{24} - \frac{BAT_c}{24} + DO_L V_L F_{14}}{V_H F_{14}}$$

where:

DO_R = Approximate dissolved oxygen remaining (mg/l)

DO_A = Ambient dissolved oxygen of water flushing into marina (mg/l)

DO_L = Dissolved oxygen level in marina at low tide (mg/l)

V_p = Tidal prism volume (m^3)

T_f = Flushing time (hours)

V_L = Volume of marina at low tide (m^3)

T_c = Tidal cycle (hours)

DO_s = Saturated dissolved oxygen concentration (mg/l)

k_1 = Reaeration coefficient (day^{-1})

B = Sediment oxygen demand ($mg/m^2/day$)

C_B = Biochemical oxygen demand mass discharge (mg/day)

A = Surface area of basin (m^2)

F_{14} = 1000 (converts cubic meters to liters).

This equation gives DO conditions at high tide. It assumes all the oxygen demand is exerted completely within the cycle. To determine subsequent tidal cycle DO values, run the equation again using the new value of DO_R in place of DO_L. Initially, the value of DO_L is set equal to DO_A, which is assumed constant over the period of analysis. Reaeration due to mixing, photosynthesis or other sources is not considered. Loss of DO due to nitrification also is not considered.

Values for "k_1" should be determined for the specific site considered. If these values are not available, an approximate solution may be obtained using $k_1 = 0.2\ day^{-1}$. Dissolved oxygen concentrations at saturation can be obtained from Table 4-13 which represent values for water saturated air at standard pressure. Values for "C_B" are estimated by use of Equation (13) with "M" equal to the average daily discharge of BOD and the value for "k" being the BOD reaction rate given in Table 4-12. The value for "B", the sediment oxygen demand, can be estimated from Table 4-14.

It is assumed that there is no increase in oxygen levels within the basin due to biological activity, that dissolved oxygen carried in by tidal flushing is retained within the basin, and that benthic oxygen demand is uniform throughout the basin.

Open Marinas

Pollutant concentrations from marinas located on rivers or estuaries can be estimated by various estuary or river dilution or dispersion equations. The fraction of freshwater method discussed previously for flushing (Section 4.2.1) allows estimation of a conservative pollutant concentration from a marina located on an estuary. Assuming that the marina site acts as a point source outfall, the following can be used to estimate pollutant concentration throughout the estuary (USEPA, 1982):

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TABLE 4-13

SOLUBILITY OF OXYGEN IN WATER

Temp. in °C	Chloride Concentration in Water - mg/l				
	0	5,000	10,000	15,000	20,000
	Dissolved Oxygen - mg/l				
0	14.60	13.72	12.90	12.13	11.41
1	14.19	13.35	12.56	11.81	11.11
2	13.81	12.99	12.23	11.51	10.83
3	13.44	12.65	11.91	11.22	10.56
4	13.09	12.33	11.61	10.94	10.30
5	12.75	12.02	11.32	10.67	10.05
6	12.43	11.72	11.05	10.41	9.82
7	12.12	11.43	10.78	10.17	9.59
8	11.83	11.16	10.53	9.93	9.37
9	11.55	10.90	10.29	9.71	9.16
10	11.27	10.65	10.05	9.49	8.96
11	11.01	10.40	9.83	9.28	8.77
12	10.76	10.17	9.61	9.08	8.58
13	10.52	9.95	9.41	8.89	8.41
14	10.29	9.73	9.21	8.71	8.24
15	10.07	9.53	9.01	8.53	8.07
16	9.85	9.33	8.83	8.36	7.91
17	9.65	9.14	8.65	8.19	7.78
18	9.45	8.95	8.48	8.03	7.61
19	9.26	8.77	8.32	7.88	7.47
20	9.07	8.60	8.16	7.73	7.33
21	8.90	8.44	8.00	7.59	7.20
22	8.72	8.28	7.85	7.45	7.07
23	8.56	8.12	7.71	7.32	6.95
24	8.40	7.97	7.57	7.19	6.83
25	8.24	7.83	7.44	7.06	6.71
26	8.09	7.69	7.31	6.94	6.60
27	7.95	7.55	7.18	6.83	6.49
28	7.81	7.42	7.06	6.71	6.38
29	7.67	7.30	6.94	6.60	6.28
30	7.54	7.17	6.83	6.49	6.18
31	7.41	7.05	6.71	6.39	6.08
32	7.28	6.94	6.61	6.29	5.99
33	7.16	6.82	6.50	6.19	5.90
34	7.05	6.71	6.40	6.10	5.81
35	6.93	6.61	6.30	6.01	5.72
36	6.82	6.51	6.20	5.92	5.64

Source: APHA, 1980.

TABLE 4-14

SEDIMENT OXYGEN DEMAND

Type of Bottom	Typical Value (g/m2/day)
Estuarine mud	1.5
Sandy	0.5
Mineral soils	0.07

Source: USEPA, 1978

$$(15)\quad C_o = \frac{Qp}{F_{14}I_S}\left(\frac{S_w - S_i}{S_w}\right),$$

$$(16)\quad C_d = C_o\left(\frac{S_w - S_x}{S_w - S_i}\right), \text{ and}$$

$$(17)\quad C_u = C_o\left(\frac{S_x}{S_i}\right)$$

where:

C_o = Cross-sectional average concentration in the segment (with the marina at point of discharge (mg/l)

C_d = Concentration of the pollutant down-estuary from the marina at a distance X (mg/l)

C_u = Concentration of the pollutant up-estuary from the marina at a distance X (mg/l)

Q_p = Mass of pollutant discharged per tidal cycle (mg)

I_s = Sum of freshwater discharges into estuary over one tidal cycle (m^3)

S_w = Sea water salinity (o/oo)

S_i = Salinity in discharge segment (o/oo)

S_x = Salinity in segment at distance X (o/oo).

This method is most appropriate for approximating concentrations of conservative pollutants. Non-conservative pollutants would exhibit lower concentrations than would be computed by this method. A dispersion type equation can provide a more accurate method of predicting pollutant concentrations from a marina in an estuary.

Dispersion Methods

Estuaries

A one dimensional dispersion equation can be used to provide estimates of pollutant concentrations without the aid of a computer. Such an equation is represented as follows (USEPA, 1982):

(18) $$C_d = \left\{ \frac{F_{18}W}{A_x(U^2 + 4kE)^{1/2}} \right\} \exp \left\{ \left[\frac{U}{2E} \left(1 - \sqrt{1 + \frac{4kE}{U^2}} \right) X \right] \right\}$$

(19) $$C_u = \left\{ \frac{F_{18}W}{A_x(U^2 + 4kE)^{1/2}} \right\} \exp \left\{ \left[\frac{U}{2E} \left(1 + \sqrt{1 + \frac{4kE}{U^2}} \right) X \right] \right\}$$

where:

C_d and C_u are as defined previously

W = Discharge rate of pollutant (mg/day)
A_x = Cross-sectional area of estuary at point X (m^2)
U = Freshwater flow velocity near discharge (m/day)

$$U = \frac{24I_s}{T_cA_x}$$

k = Reaction rate coefficient for pollutant (day^{-1})
E = Dispersion coefficient (m^2/day)
X = Distance from marina (m)
F_{18} = 1×10^{-3} (converts units to mg/l).

If values for the dispersion coefficient are unknown, they can be estimated by the following:

(20) $$E = \frac{2U\overline{S}\,\Delta x}{(S_{x+\Delta x} - S_{x-\Delta x})}$$

where:

E = Dispersion coefficient (m^2/day)

U = Freshwater velocity in vicinity of marina (m/day)

$\overline{S}$ = Tidally and cross-sectionally averaged salinity in vicinity of marina (o/oo)

Δx = Distance up or down estuary from marina at which salinity measurements are made (m)

$S_{x+\Delta x}$ = Salinity at distance Δx down the estuary (o/oo)

$S_{x-\Delta x}$ = Salinity at distance Δx up the estuary (o/oo).

Use of Equations (18) and (19) requires assumptions that the pollutant decay reaction rate is first order, the cross-sectional area of the estuary is relatively constant over distance, and the estuary is relatively long and completely mixed. Shorter estuaries will probably not attain equilibrium required by this method and pollutants would probably flush out rapidly. For these conditions use of Equations (15), (16) and (17) would probably be appropriate with the assumption that all pollutants behave conservatively.

Estimations for dissolved oxygen depletion as a result of BOD imposed from the marina may be obtained as follows (USEPA, 1982):

$$DO_R = DO_s - DO_d \tag{21}$$

where:

DO_R = Final concentration of dissolved oxygen (mg/l)
DO_s = Concentration of dissolved oxygen at saturation (mg/l)
DO_d = Dissolved oxygen deficit (mg/l).

The value for DO_d can be calculated by the following:

$$DO_d = \frac{F_{18} k_2 W_L}{A_x (k_1 - k_2)} \left[\frac{1}{\sqrt{Z_1}} \exp\left(\frac{U \pm \sqrt{Z_1}}{2E} \; X \right) - \frac{1}{\sqrt{Z_2}} \exp\left(\frac{U \pm \sqrt{Z_2}}{2E} \; X \right) \right] \tag{22}$$

where:

W_L = BOD from discharge plus background BOD (mg/l)
$Z_1 = U^2 + 4k_2E$
$Z_2 = U^2 + 4k_1E$
k_1 = reaeration rate (day^{-1})
k_2 = BOD decay rate (day^{-1})
$\pm$ = Plus sign used to compute concentrations up estuary
Minus sign used to compute concentrations down estuary
All other parameters are as defined previously.

Equation (22) assumes that negligible amounts of dissolved oxygen are added to the estuary from pollutant discharge in the marina. If site-specific BOD values are not available, the value from Table 4-12 may be used.

Rivers

For marinas located along rivers, approximations of pollutant concentrations downstream can be made as follows:

$$C_X = \frac{F_{18} W}{Q} \exp -k \frac{X_R}{24 U_v} \tag{23}$$

where:

C_X = Concentration of pollutant at point X downstream (mg/l)
W = Discharge rate of pollutant (mg/day)
Q = Volumetric river flow rate (m^3/day)
k = Reaction rate coefficient for pollutant (day^{-1})
X_R = Distance downstream (m)
U_V = River velocity (m/hr).

This computation assumes complete mixing from the marina location downstream, relatively uniform channel widths and depths, first order decay of pollutant, and relatively constant flow rate.

Estimations of downstream dissolved oxygen concentration as a result of biochemical oxygen demand imposed by the marina can be computed as follows:

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$$DO_R = DO_S - DO_A \exp\left(\frac{-k_1 X_R}{24U_V}\right) - \frac{F_{18} W_L k_2}{Q(k_1 - k_2)}\left[\exp\left(\frac{-k_2 X_R}{24U_V}\right) - \exp\left(\frac{-k_1 X_R}{24U_V}\right)\right]$$

where:

W_L = Discharge rate of BOD (mg/day)
DO_A = Initial dissolved oxygen concentration in the river (mg/l)
All other parameters are as defined previously.

The reaeration rate, k_1, for rivers will change along the river depending upon various river characteristics. However, an estimate of k_1 may be obtained by the following equation (O'Conner and Dobbins, 1958):

$$k_1 = \frac{(D_L U_V)^{1/2}\ 24}{H\ 3/2}$$

where:

k_1 = Reaeration coefficient (day^{-1})

D_L = Diffusivity of oxygen in water = 7.53 x 10^{-6} m^2/hr at 20°C

U_V = Flow velocity (m/hr)

H_r = Depth of flow (ft).

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Sanitary Wastes From Boats

One pollutant source of major concern is the discharge of sanitary wastes from boats in marinas or adjacent waterways. Boat sewage can be visually repulsive (Chmura and Ross, 1978) and may contribute to increased biochemical oxygen demand (BOD) in receiving waters (OCZM, 1976). BOD is a measure of the dissolved oxygen required to stabilize the decomposable matter present in a water body by aerobic biochemical action. When BOD increases, there is a consequent reduction in dissolved oxygen available for respiration by aquatic organisms. Resulting DO estimates can be calculated using Equations (23) or (24).

The most serious effect of discharging fresh fecal material is the potential for introducing disease-causing viruses and bacteria (pathogens). Problems may occur if boat sewage is released in the vicinity of shellfish (clam or oyster) beds or into enclosed waterways with limited flushing. Shellfish require clean water to be microbiologically safe for human consumption, regardless of whether they are eaten raw or partially cooked. Fecal coliform bacteria, other bacterial pathogens, and viruses found in water and sediments are concentrated by shellfish, depending upon temperature, density of pathogens, salinity, currents, depth, water chemistry, and shellfish feeding activity (Van Donsel and Geldreich, 1971; Metcalf and Stiles, 1968). Once concentration of pathogens has occurred, microorganisms will not necessarily be flushed at the same rate (Janssen, 1974; Kelly and Arcisy, 1954). Known enteric pathogens associated with feces-contaminated shellfish include typhoid fever, dysentery, gastroenteritis, and infectious hepatitis (NSSP, 1965).

Currently, total and fecal coliform bacteria counts are used as indicators of fecal contamination because these bacteria are always present in the human intestinal tract. An increase in the density of pathogens is indicated by higher coliform counts. . However, recent investigations reveal that fecal coliform counts in surface waters do not reflect the level of viral contamination of shellfish (Ellender et al., 1980; Sobsey et al., 1980; Gerba et al., 1980; Vaughn et al., 1980). Viral epidemics attributed to shellfish ingestion most frequently involve hepatitis virus type A.

Estuarine sediments are being examined for their role in the pathogenic contamination of shellfish. Studies demonstrate that indicator bacteria and bacterial pathogens do not survive for extended periods in estuarine sediments (Chang et al., 1971 and Gerba et al., 1980). However, indicator bacteria survive longer in seawater to which sediment has been added than in seawater alone (Ellender and Cook, 1982). Viruses bind to sediment particles by covalent bonds or electrostatic forces, apparently increasing the long-term survival of virus in sediment. The relationships of viruses in shellfish to viruses in estuarine sediments have yet to be clearly defined.

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Several studies have reported an increase in coliform counts in water and shellfish due to the presence of boats. In a brief summer study, Udell (1956) showed that sampling stations associated with heavy boat use showed higher levels of fecal contamination than stations outside of anchorage areas. Udell (1957-1963) conducted field studies on several areas subject to boat wastes and concluded that where tidal exchanges were large, no detectable increases in pollution level attributable to boats were apparent. Further, the degree of pollution in confined coves was directly proportional to the number of boats anchored or docked. Since the boat population varied, pollution levels were not consistent. Udell further concluded that bacterial densities did not exceed shellfish classification standards at all times. It should be noted that this study predated more restrictive Coast Guard standards for marine sanitation devices.

Watercraft concentrated in marinas or in coves or bays for several days can have noticeable short-term effects on the number of enteric bacteria in the aquatic environment (Furfari and Verber, 1969). During the summer, the primary source of coliforms in water and shellfish in a Rhode Island cove was reported to be boat waste. A positive correlation between the number of boats in the Rhode River estuary (Chesapeake Bay) and fecal coliform concentrations has also been reported by Faust (1982). The bacteria levels in the water decreased when the boats departed after a holiday weekend. Faust (1982) recognized that the pollution generated per boat is dependent on the degree of dilution in moving water. Barbaro et al. (1969) found that, during the summer boating season on a Mississippi reservoir, marina waters contained higher coliform counts than non-marina waters. In another study, it was shown that coliforms in water and shellfish increased in direct relation to the small boat population of a New York estuary on a holiday weekend (Cossin and Frenke, 1971). Mack and D'Itri (1973) found that fecal coliforms increased in the marina slips used most frequently by yachts. Similarly, an increase in fecal coliform or fecal streptococci bacteria was found to be associated with areas frequented by boaters (Kidd, 1975; Mack, 1971; Bowerman and Chen, 1971; Seabloom, 1969).

Studies of boat wastes, however, can be confusing and inconclusive because coliform counts vary with temperature, turbidity, boat densities, tides, day of the week, season of the year, and the number of persons aboard each boat (Furfari, 1968; Faust, 1982). Researchers have found that water quality in some areas is so variable that the effect of pollution due to concentrated boat use alone cannot be measured (USPHS, 1967a). Sometimes, the background level of coliforms from land-based sewage is so high that boating-related impacts are masked (Nixon et al., 1973; Faust, 1982). There is no epidemiological evidence that boat wastes cause disease. However, raw feces discharged from boats contain pathogens which, when concentrated by shellfish, might transmit disease (Furfari, 1968). It is apparent that sewage from vessels may pose localized environmental problems.

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Coliform bacteria are commonly used as an index of fecal contamination because they are easily identified and counted. Shellfish waters historically have been classified on the basis of total coliform levels such as those promulgated by the National Shellfish Sanitation Program (NSSP), a division of the U.S. Public Health Service (Table 4-15). The NSSP Manual of Operations (NSSP, 1965) recommends that shellfish be taken from "approved areas" having median total coliform counts of less than 70/100 ml. Guidelines specifically related to the presence of marinas in shellfish grounds are not offered by NSSP.

Because many state shellfish authorities believed that this Manual of Operations (NSSP, 1965) did not provide sufficient guidance for classification of shellfish growing waters adjacent to marinas, the U.S. Food and Drug Administration Division of Shellfish Sanitation promulgated National Policy Guidelines for use by state shellfish officials (USFDA, 1972). In summary, these guidelines state that:

- Boats are a source of fresh fecal pollution which is a hazard to public health
- The "approved area" criterion of median total coliform counts of 70/100 ml does not apply (to marinas) because:
    - there are unpredictable aspects of boat pollution
    - the pathogen-to-coliform ratio is different in fresh fecal material than in municipal sewage from which the 70/100 ml coliform count criterion was derived
    - usual sampling techniques for coliforms do not apply to fresh fecal material
- The NSSP Manual of Operations clearly states that pollution from boats is a public health problem requiring special consideration for proper classification
- Because of the highly variable and unpredictable contribution of fresh fecal material, it is necessary to close areas subject to boat pollution in the vicinity of shellfish beds during the boating season.

The USFDA (1972) went on to reiterate and emphasize the point made by NSSP (1965) that areas meeting the 70 coliform/100 ml "approved area" criterion and which were protected against fresh fecal contamination would not be involved in the spread of disease. Furthermore, the USFDA was able to calculate the number of boats (prior to the use of marine sanitation devices) that could be permitted in an area of given size and depth while still meeting the less than 70/100-ml-coliform criteria (Table 4-16). As an example of the impact of fresh fecal material, USFDA (1972) calculated that, since there is a much higher proportion of pathogens in fresh fecal material than there is in municipal sewage (from

TABLE 4-15

CLASSIFICATION OF SHELLFISH GROWING AREAS PROMULGATED BY NATIONAL SHELLFISH SANITATION PROGRAM[a]

Area classification	Criteria[b]
Approved	a. Area not contaminated with fecal material such that consumption of shellfish might be hazardous;
	b. Area not contaminated by radionuclides or industrial wastes such that consumption of shellfish might be hazardous;
	c. Total coliform median MPN does not exceed 70/100 ml and not more than 10 percent of samples have counts exceeding 230/100 ml.
Conditionally approved	a. Water quality requirements must meet those for "approved areas" as above;
	b. Operating procedures to develop performance standards by joint action of all concerned agencies;
	c. Closed safety zone between shellfish areas and source of pollution;
	d. Boundaries of closed safety zone marked;
	e. Minimization of chance of failure or overloading of sewerage systems through proper design, construction, maintenance and acceptable performance standards;
	f. Mutual understanding of purpose of conditionally approved status by all concerned agencies;
	g. Failure to meet performance standards immediately reported to the responsible state agency;
	h. Closure of area by the responsible state agency if failures occur;

TABLE 4-15
(continued)
CLASSIFICATION OF SHELLFISH GROWING AREAS PROMULGATED BY NATIONAL SHELLFISH SANITATION PROGRAM[a]

Area classification	Criteria[b]
Conditionally approved (cont'd)	i. Responsible state agency conducts at least two evaluations of area during harvesting season;
	j. Area reverts to restricted or prohibited classification if it is discovered that failures have not been reported;
	k. All data on area maintained by the responsible state agency.
Restricted	a. Area is contaminated with fecal material such that consumption of shellfish may be hazardous;
	b. Area is contaminated with radionuclides or industrial waste such that consumption of shellfish may be hazardous;
	c. Total coliform median MPN does not exceed 700/100 ml and not more than 10 percent of samples have counts exceeding 2300/100 ml.
Prohibited	a. Area is contaminated with radionuclides or industrial wastes such that consumption of shellfish may be hazardous; or, total coliform median MPN exceeds 700/100 ml and not more than 10 percent of samples exceed 2300/100 ml;
	b. No market shellfish may be taken from prohibited areas except after controlled purification;
	c. Coastal areas where sanitary surveys have not been made are automatically considered prohibited.

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[a] NSSP, 1965.

[b] All criteria are based on the results of a sanitary survey verified by laboratory analyses.

TABLE 4-16

ALLOWABLE NUMBER OF BOATS IN SHELLFISHING AREAS[a]

Area of marina in square miles	Depth feet	Number of boats
0.1	5	3
	10	6
	15	9
	20	12
	25	14
	30	17
	40	23
0.25	5	7
	10	14
	15	21
	20	28
	25	36
	30	42
	40	56
0.5	5	14
	10	28
	15	42
	20	56
	25	70
	30	84
	40	112
1.0	5	28
	10	56
	15	84
	20	112
	25	140
	30	184
	40	224

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[a] USFDA, 1972. The "allowable" number of boats is the number of boats that would yield total coliform counts of 70/100 ml or less. These data were presented prior to requirements for MSD installation and assume input of untreated fecal waste by all boats.

which the 70 coliforms/100 ml criterion was derived), a count of 2 coliforms/100 ml derived from fresh fecal material was equivalent to a count of 70 coliforms/100 ml derived from municipal sewage. From these calculations, USFDA was able to project the expected concentration of coliform bacteria from a given number of boats in an area of given size and depth (Table 4-17). These calculations indicate that, to maintain the water quality necessary for shellfish to be safely grown, only a few boats (assuming discharge of untreated, fresh fecal material) can be allowed in relatively large, deep marinas. However, these calculations do not take into account the survival time of fecal coliforms or the influx of fecal coliforms from non-point sources.

In a study of the Rhode River estuary in Chesapeake Bay, it was estimated that a water volume of 10 to 20 x $10^4 m^3$ per boat was necessary to dilute fecal coliform concentration in the water below 14 coliforms/100 ml, the recommended safe level for shellfish harvesting in the Chesapeake Bay (Faust, 1982). This estimate was based on a fecal coliform survival time of 12 hours and four people per boat, with each person producing 2.9 x 10^9 fecal coliforms per half day. The estimate agreed with the 13.7 x $10^4 m^3$ of dilution water per boat reported in an earlier study in Rhode Island (Furfari, 1968).

The USEPA and the U.S. Coast Guard have promulgated regulations that require the use of permanently installed marine sanitation devices (MSDs) on boats having heads. On inland waters, such as lakes, Type III MSDs, which are holding tanks that prevent discharge of any kind, must be used. Boats on marine waters may utilize Type I, Type II or Type III MSDs, which release treated sewage, if the effluent meets certain water quality specifications (Table 4-18). These specifications exceed the coliform specifications of the NSSP (1965).

Use of MSDs in the prescribed manner is designed to reduce the amount of raw fecal matter discharged by boats, but other problems may arise from their use. Type III MSDs can be too large and cumbersome for some boats and their use is predicated on the availability of pumpout facilities at marinas (OCZM, 1976). Pumpout facilities are not common at southeastern coastal marinas (Table 2-1) and apparently see limited use from larger boats over 25 feet in length (Rogers and Abbas, 1982). In addition, the disinfectants used by Type III MSDs, primarily formalin, can cause marina septic systems to be less efficient and may cause increased leaching of septic system wastes and their fecal pathogens into marina waters (OCZM, 1976; Rogers and Abbas, 1982). An alternative to holding tanks is the use of Type I and II MSDs that release physically and chemically treated fecal wastes to the water. Boats using Type I and Type II MSDs ideally restrict their use to well flushed coastal waters and prohibit sewage discharge in marinas, waters used for water contact sports and areas from which aquatic organisms are harvested for food (Boozer, 1979). The proper use and maintenance of these MSDs is impossible to enforce, however. It is estimated that only 25 percent of all recreational vessels comply with the federal requirements for MSDs (USEPA, 1981a).

CONCENTRATION OF COLIFORM EXPECTED FROM GIVEN NUMBERS OF BOATS PER 100 ml[a]

Area of marina in square miles	Depth feet	Number of boats				
		10	50	100	200	500
0.1	5	6.3	32	63	126	315
	10	3.1	16	31	62	156
	15	2.1	10	21	42	104
	20	1.6	7.8	16	32	78
	25	1.3	6.3	13	26	63
	30	<1	5.2	10	20	52
	40	<1	3.9	7.8	16	39
0.25	5	2.5	12.5	25	50	125
	10	1.3	6.3	13	26	63
	15	<1	4.2	8.3	16	42
	20		3.1	6.3	12	31
	25		2.5	5.1	10	25
	30		2.1	4.2	8	21
	40		1.6	4.3	6	16
0.5	5	1.3	6.3	13	26	63
	10	<1	3.1	6.3	12	31
	15		2.1	4.2	8	21
	20		1.6	3.2	6	16
	25		1.3	2.5	5	13
	30		1.1	2.1	4	11
	40		<1	1.6	3.8	
1.0	5	<1	3.2	6.3	12	32
	10		1.6	3.2	6	16
	15		1.1	2.1	4	11
	20		<1	1.6	3	8
	25			1.3	2.6	6
	30			1.1	2.2	5
	40			<1	<1	4

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[a] USFDA, 1972. A coliform count of 2/100 ml from fresh fecal material was found to be equivalent to a count of 70/100 ml from municipal sewage. Therefore, counts above and to the right of the dividing lines represent unacceptable levels of fecal contamination. These data were presented before MSDs were required and assume input of untreated fecal waste by all boats.

TABLE 4-18

WATER QUALITY SPECIFICATIONS FOR MARINE SANITATION DEVICE DISCHARGES[a]

MSD type	Coliform count[b]	Solids
I	<1000/100 ml	no visible floating solids (<10% of total suspended solids discharged)
II	<200/100 ml	<150 mg total suspended solids per liter of discharge
III	None	None

[a] Coast Guard Regulations on Marine Sanitation Devices, as amended through 3 February 1983.

[b] Represents the arithmetic mean of the fecal coliform bacteria in 38 of 40 samples when tested in accordance with 40 CFR, Part 136.

Formalin (diluted formaldehyde solution) and chlorine, two of the chemical treatments used in MSDs, may harm marine organisms, although views differ (USEPA, 1981a). Chlorine has been shown to be toxic in the aquatic environment and oysters in particular are sensitive to chlorine and chlorine products (Scott and Middaugh, 1978; Scott and Vernberg, 1979). A chlorine level of 0.05 ppm can be fatal to oyster larvae, and the effective disinfection of sewage wastes requires chlorine levels greater than 0.05 ppm (Zoellner, 1977). In general, the toxicity of chlorine compounds is a function of concentration, contact time, and chemical form (USEPA, 1981a). Data available on formaldehyde indicate that it is degradable and the potential for bioaccumulation is low. USEPA (1981a) reports that formalin reacts chemically with sewage from watercraft and is changed in the process to relatively harmless substances that are unlikely to cause any significant adverse effects. No data are available to substantiate a link between chlorine or formalin, when used specifically as MSD disinfectants, with effects on the environment.

Marina sites in the vicinity of harvestable shellfish beds represent potential sources for bacterial contamination of the shellfish. Therefore, issues related to the potential for contraventions of state water quality standards in waters classified as suitable for shellfish propagation and harvesting may arise. The following methods available for predicting impacts from boat wastes may not be conclusive because coliform counts vary with temperature, turbidity, boat densities, tides, day of the week, season of the year, and the number of persons aboard each boat.

Empirical Methods

In addition to the dilution and dispersion methods that can be used for predicting fecal coliform concentrations that were previously presented, the contribution of boats to fecal coliform pollution of the water can be estimated by methods used by FWPCA (1967), USFDA (1972), Faust (1982), Furfari (1968), and SCDHHS (1982). Many of these studies were directed toward estimating the number of boats allowable in a shellfishing area. Although specific bacteriological standards for the concentration of coliform bacteria in boating waters have not been established, estimates of the concentration of coliforms may be made using existing bacteriological criteria for treated wastewater.

Dye Study

The USFDA, National Technical Services Unit (1972) has estimated the expected concentrations of coliform bacteria from the number of boats in an area, the population equivalent per boat and the volume of water available for dilution of discharged fecal material. These estimates were derived as:

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$$(25)\quad \text{MPN}/100\ \text{ml} = \frac{GP}{F_{25}V_L}$$

where: MPN = Most probable number
G = No. of boats
$P = 2.5 \times 10^9$ coliforms per boat
V_L = Volume of water at low tide
$F_{25} = 1 \times 10^4$ (converts units to MPN/100 ml).

Table 4-17 showed some representative values derived from these calculations. The results assume initially coliform-free water and input of untreated fecal waste from every boat.

The population equivalent (P) used in these calculations was based on 1.25 people/boat (FWPCA, 1967). This is based on an average of 3.6 people per boat, 5.6 hours per trip. Using 16 man-working hours in a day, one boat is equivalent to:

$$(26)\quad \frac{3.6 \times 5.6}{16} = 1.25 \text{ people}$$

The contribution of coliforms per person was 2×10^9 coliforms/day (Geldreich, 1966). This value is generally accepted by most authorities (Clark, 1982). Thus:

$$(27)\quad P = (1.25 \text{ people/boat})(2 \times 10^9 \text{ coliforms/person}) = 2.5 \times 10^9 \text{ coliforms per boat}$$

The estimated numbers of boats allowed are based on the 70 MPN/100 ml "Approved Area" criteria for shellfish waters. However, for the reasons previously discussed, the USFDA (1972) feels that the "Approved Area" criterion of 70 Coliform MPN/100 ml does not apply to sanitary waste from boats.

Similar calculations for the amount of water required to dilute fecal coliforms to acceptable levels for shellfish waters have been variable because of the assumptions used. Values reported are:

- Between 1.0 and 2.0 x 10^5 m^3 of water per boat to achieve a concentration of 14 MPN/100ml (Faust, 1979)
- 1.37 x 10^5 m^3 for "safe levels" (Furfari, 1968)
- 1.4 x 10^5 m^3 for "safe levels" (USFDA, 1972).

Dye studies also may be used to predict coliform concentrations at proposed marinas. Flows available for dilution of bacteria are calculated by dividing the area under time-concentration curves by the amount of dye released. Resulting dilution volumes can be used to estimate the concentration of coliforms at specified distances from a proposed marina.

This technique has been used to estimate the fecal coliform concentrations resulting from a proposed marina in South Carolina (SCDHHS, 1982). The assumptions used to predict coliform contribution were:

- 100 boats
- 2 people per boat discharging fecal coliforms over a twelve-hour period (one every 3.6 minutes)
- 2×10^9 coliforms per person per discharge
- 12 hour time period.

The flow of coliforms was calculated as:

$$(28) \quad \frac{2.0 \times 10^9 \text{ coliforms/person} \times 200 \text{ people}}{12 \text{ hrs.} \times 3{,}600 \text{ seconds/hr.}} = 9.25\text{x}10^6 \text{ coliforms/sec}$$

The concentrations of coliforms at specified distances from the marina was calculated as:

$$(29) \quad \frac{9.25 \times 10^6 \text{ coliforms/sec.}}{(\text{Flow in m}^3\text{/sec})F_{25}} = \text{coliforms/100ml}$$

Although performing a hydrological survey is expensive, use of the dye study in conjunction with estimated coliform contribution can provide more accurate approximations to actual coliform concentrations than the previously discussed empirical methods.

The volume needed to provide the USFDA's (1972) $1.4 \times 10^5 m^3$ of water per boat for 100 boats is more than twice the amount of water required according to results obtained with the dye studies and assumptions made (SCDHHS, 1982).

Impact Evaluation

Several methods have been presented for predicting the potential coliform concentration resulting from sanitary waste discharge in a marina basin or adjacent waters. Potential impacts to shellfish areas or water quality can be estimated by comparing results from any of these methods with the state water quality standards for the classification of waters in which the marina is located.

Evaluating the level of impact based on results from these predictive methods is complicated by the assumptions required. The only variable with a widely accepted value is the 2×10^9 coliforms per person. Choice of values for the remaining required parameters can significantly affect the estimates of coliform concentrations obtained. Complicating these assumptions are the following unpredictable aspects of boat or vessel pollution (USFDA, 1972):

- Variable population
- Mobility
- Intermittent pollution contribution
- Varying modes of treatment ranging from none to holding tanks
- Treatment devices with varying ranges of efficiency which have not been proven or generally accepted
- The epidemiological background of a transitory population contributing fresh fecal pollution is not well defined.

4.2.6 Boat Operation and Maintenance

Many of the water quality impacts of boat operation and maintenance on the environment are subtle and most have not received the scientific attention required to assess them. In addition to sanitary waste discharges, other pollutants include outboard exhaust and other engine pollutants, lead, copper and detergents. The impacts associated with these pollutants range from acute toxicity to slight perturbations.

Pollutants from Boat Operation

Motorized boats are propelled by inboard, outboard, or inboard/outboard engines. This discussion centers on outboard motors since the majority (over 75 percent) of motors used by recreational boaters are of the outboard type (NMMA, 1983), and because most research on the environmental effects of boat motors has centered on outboards (Chmura and Ross, 1978).

Two-cycle engines (outboards) are less efficient than four-cycle engines (inboards and inboard/outboard). Unlike four-cycle engines, fuel intake and exhaust are accomplished in the same stroke in two-cycle engines. Unburned fuel can be released with exhaust gases as a result of this combination of strokes. Although a deflector is often constructed on the piston to help prevent the incoming fuel-air mixture from passing across the cylinder and out the exhaust manifold, unburned fuel is still discharged with the exhaust gases, decreasing efficiency and adding pollutants to the water (Jackivicz and Kuzminski, 1973).

Pollutants can result from the manner in which two-cycle engines are lubricated. Lubricants cannot be used directly in the crankcase of a two-cycle engine because the crankcase must be airtight to force the fuel-air mixture into the cylinder during the downward power stroke of the piston. Thus, oil must be mixed with the fuel to reach and lubricate internal engine parts. In pre-1972 outboards, excess oil that accumulated in the engine was discharged directly into the water through a valve in the crankcase. Starting in 1972, outboards were equipped with drainage recycling ("scavenger") devices to recycle this excess oil back into the fuel system. The amount of oil discharged into the water is significantly reduced with these newer outboard motors. These outboards can discharge an estimated average of 10 to 20 percent (Muratori, 1968). Beginning in 1984 some larger horsepower outboard motors incorporated more sophisticated lubrication systems in which the fuel-to-oil mixture ratio is varied to match the operating speed of the motor. This arrangement is designed for more efficient motor operation and reduction of oil consumption. A reduction of unburned oil discharges may also result from this system.

The quantity of substances discharged into the water varies with features of the motor, such as size, deflector design, intake and exhaust design, and recycling apparatus, and with operating variables, including gasoline-oil fuel ratio, speed of operation and tuning of the engine (Jackivicz and Kuzminski, 1973). Depending on these variables, a maximum of 55 percent of the original fuel can be discharged into receiving waters (Jackivicz and Kuzminski, 1973).

The major components discharged during outboard operation are carbon monoxide, carbon dioxide, hydrocarbons, and lead. A USEPA (1974a) study identified the following components and concentrations in outboard motor exhaust from motors with and without drainage recycling devices and of varied horsepowers:

- Carbon monoxide in emissions ranged from 4.5 percent at 1000 rpm to 6.5 percent at 5000 rpm
- Carbon dioxide ranged from 5.4 percent at 1000 rpm to 7.5 percent at 4000 rpm
- Hydrocarbon concentration ranged from 7.75 parts per thousand (ppt n-hexane) at 1000 rpm to a low of 4.5 ppt at 4000 rpm
- Lead varied from 1.84 percent to 12 percent of the lead in the fuel (Kuzminski and Mulcahy, 1974).

The hydrocarbons in exhaust gases were composed of 20-30 percent olefins, 20-30 percent aromatics and approximately 50 percent paraffins (USEPA, 1974a). Hydrocarbons also can be released with bilge water that is drained or pumped from boats. Pollution from bilge pumping is normally a problem in major shipping areas and is cumulative. Hydrocarbons may be introduced into the aquatic system by spillages at docks and fueling areas.

Once exhausts are released into the water, some of the hydrocarbons become suspended in the water column while others evaporate at the surface (Kuzminski et al., 1973). Some of the carbon oxides may dissolve in the water, depending on solubility (primarily temperature related), although most will dissipate into the atmosphere. Kuzminski and Mulcahy (1974) report that lead emission is dependent on the speed of operation and prior operational history of the motor. Almost all of the lead that is discharged eventually reaches bottom sediments (Kuzminski and Mulcahy, 1974). However, unleaded fuel can be used in most modern outboard motors.

Pollutants from Boat Maintenance

Other sources of pollutants are derived from boat maintenance activities, including fiberglass repair, washing, sanding and painting. Detergents are introduced to the water when boats are washed. Sanding and painting boats add toxic materials to the aquatic environment from antifouling paints. Antifouling paints are also used on floats and buoys within a marina. Although once a problem, major brands of antifouling paints currently in use do not contain significant amounts of PCBs (polychlorinated biphenyls). Young et al. (1974) found that only 7 of the 28 paints commonly used yielded detectable PCB levels; of these, median concentrations were less than 0.7 mg/l and the maximum concentration measured was 40 mg/l. Copper, on the other hand, is a heavy metal commonly used in antifouling paints. Young et al. (1974) estimated a median copper concentration of 600 mg/l in paints tested. However, copper contamination is typically not a problem when marinas are well flushed (Boozer, 1979).

4.3 Ecological Impacts

4.3.1 Aquatic Habitat Resources

Marinas are usually located in estuaries which are among the most diverse of all habitats. As such, they contain many plant and animal communities that are of economic, recreational, ecological or aesthetic value. These communities are frequently sensitive to habitat alteration that can result from marina development and operation.

Pollutant Impacts

Research is lacking concerning the chronic effects of low level pollutant discharges into coastal water systems. The principles gained from northern studies, freshwater studies, and laboratory studies may not always be applicable to southeastern and Gulf coast nearshore waters. Most studies concerning the effects of hydrocarbons on marine fauna have been after major oil spills, where the amount of hydrocarbon pollutants is considerably greater than would occur from outboard exhausts. These studies (included in Hart and Fuller, 1979) showed that the areas of concern regarding oil pollution were direct lethal toxicity, sublethal disruption of physiological or behavioral responses (of which extremely little is known), persistence and accumulation of oil in invertebrates that is passed up the food web chain, destruction of habitat, and damage to fishery resources through tainted shellfish or finfish meat (Moore and Dwyer, 1974; Dawson, 1979; Williams and Duke, 1979).

Outboard motors and petroleum spillages are definitely sources of petroleum hydrocarbons in marinas; however, there is dispute concerning their level of importance. The United Nations (1982a) has reported estimated concentrations of soluble aromatic fractions of oil which are toxic to marine organisms (Table 4-8). Some reviewers consider their occurrence more problematic than real based on the reported low incidence of oil spills in marinas (Cardwell et al., 1980), the low solubility of petroleum (particularly in quiet waters) and the relatively low acute toxicity of low levels of petroleum hydrocarbons to many species of marine organisms.

Laboratory test results have shown toxicity to be associated with outboard motor exhaust. However, these tests were conducted at higher concentrations than would be expected under actual field conditions. Nixon, et al. (1973) subjected various estuarine organisms to concentrations of up to 75 percent exhaust water. Grass shrimp (*Palaemonetes pugio*) survived for at least several hours in concentrations of 50 percent exhaust water under aerated conditions, whereas a 50 percent concentration killed mixed zooplankton in two hours. The mummichog (*Fundulus heteroclitus*), a small forage fish, showed 100 percent survival over 24 hours in concentrations of at least as high as 10 percent exhaust water. Half of the isopods (*Idotea baltica*, a small crustacean), died in less than one hour at 75 percent exhaust water; the 50 percent mortality time was 47 hours at 10 percent exhaust water.

Field studies, reported by Clark et al. (1974), suggest that small amounts of petroleum, including outboard motor wastes, may adversely affect mussels and oysters. They found that mussels (*Mytilus edulis*) were more sensitive to two-cycle outboard motor effluent than oysters (*Ostua lurida*), and that cumulative mortality in mussels after 10 days was 66 percent compared with 14 percent for oysters. Oysters can close their shells for long periods of time, thereby excluding pollutants. Mussels, however, may not be able to prevent pollutants from entering the byssal opening. Histological examination revealed that mussel gill tissue damage occurred within the first 24 hours of exposure. Oysters were not affected during the first 24 hours of exposure, but chronic exposure could be deleterious.

Field and laboratory bioassay studies have also shown that lighter petroleum products, such as diesel oil, are taken up by mussels more readily than crude oils and heavy, more viscous products (Clark et al., 1974). Under controlled conditions mussels will retain lighter petroleum products up to five weeks after the pollutant is removed. Sensitivity to petroleum products may thus be highly dependent upon the characteristics of the affected organisms as well as upon the physical properties of the hydrocarbon pollutant (Chmura and Ross, 1978; Clark et al., 1974).

Boats also may introduce heavy metals into the aquatic environment. The major source of lead in the environment, for example, is the combustion of leaded gasoline (88 percent: May and McKinney, 1981). Lead enters the aquatic environment in surface emissions, atmospheric fallout and surface runoff, as well as through subsurface outboard motor exhaust. Lead is very toxic to most plants and is moderately toxic to mammals, where it acts as a cumulative poison (Bowen, 1966). The aquatic organisms most sensitive to this metal are fish (Mathis and Kevern, 1975). Toxicity and bioaccumulation concentration factors of lead and other heavy metals in marina organisms have been documented (Table 4-7; United Nations, 1982a). The toxicity of lead in water is affected by pH, hardness, organic materials and the presence of other metals. Because of these variables, there are few data from which to draw conclusions about the relationship of safe versus toxic levels for any given species (USEPA, 1976). USEPA (1976) has determined that data are insufficient to base a marine criterion. Some states in the study area have stringent guidelines.

Data are insufficient to derive satisfactory criteria levels for copper (USEPA, 1976). Copper is distributed through the environment along several pathways, many of which make the element unavailable to aquatic organisms. Copper is available and toxic to marine organisms only when it is in its cupric form (Cu^{++}) and if it occurs in sufficient amounts (Cardwell et al., 1980).

Nixon et al. (1973) found that copper concentrations were significantly higher in the attached benthic algae, fouling communities, and sediments at a marina than in a nearby marsh. Yet copper enrichment was not found in higher tropic levels such as fish or shrimp. Young and Hessen (1974) and Young et al. (1975) found that mussels taken from boat harbors had significantly higher copper concentrations. Little is known about copper transfer through food chains or long-range impact (Chmura and Ross, 1978). The increase in copper concentration is dependent on the flushing characteristics of a marina, and only poorly flushed marinas will cause leaching to be a problem (Ervin et al., 1980).

Under normal outboard motor use, Kuzminski and Fredette (1974) found that exhaust concentrations did not inhibit the growth of two species of freshwater algae (*Selenastrum capricornutum* and *Anabaena flosaquae*). A USEPA (1974a) study found that there was no significant difference between diatom communities, plankton communities, or organic production in freshwater control ponds compared with ponds subjected to outboard motor use. Both the USEPA (1974a) study and a study by Jackivicz and Kuzminski (1973) on a Florida lake concluded that outboard motor emissions under normal field conditions do not significantly affect freshwater aquatic systems or seriously degrade water quality. Similar results for estuarine or salt water aquatic systems have not been substantiated.

Field and laboratory studies show conflicting results regarding the quantity of hydrocarbons necessary to impart noticeable tastes in fish (Chmura and Ross, 1978). The 1974(a) USEPA study reported that concentrations up to 110 ppm of fuel and water could be used before any alteration in the taste of fish was demonstrated. Another study estimated that the threshold for tainting fish flesh (from fish caught in ponds) was eight ppm (English et al., 1963). Results of studies by Kempf

(1967) showed an increase in objectionable tastes in carp with continuing exposure to outboard motor effluent water and a loss of taste when the carp were transferred from the effluent treated water. It is difficult to relate the results of these studies to coastal marinas since they rarely possess steady state conditions.

Ecological impacts also include an undesirable smell of gasoline and oil noticeable in fish and water supplies. Kuzminski et al. (1974) found that the odor threshold occurred at fuel concentrations less than 0.3 ppm. This is similar to the range of 0.5 to 1.5 ppm reported by English et al. (1963).

Marine organisms also are affected by detergents from boat washing and clothes washing either aboard boats or at marina shore facilities. Detergents introduced to the water can cause increased nutrient levels that contribute to plankton blooms and decreased dissolved oxygen concentrations. Detergents cause the most problems in marinas with limited tidal flushing, particularly if nutrients are also being added to the marina waters from other sources such as inadequate sewage disposal facilities. Detergents, including oil dispersants, may be divided into two categories: water-based compounds, which are highly toxic to fish and shellfish but not to crustaceans, and solvent-based compounds for which the reverse is true. This phenomenon is explained by the fact that fish and shellfish have gills that require contact with water while crustaceans have a waxy covering on their gills that is eroded by the solvent base. Detergent concentrations above 10 ppm are acutely toxic to shrimp and crab larvae and sublethal effects have been observed in the 0.1 to 1.0 ppm range (Hart and Fuller, 1979). Solvent-based detergent concentrations between 1.0 and 2.5 ppm are toxic to isopods, while worms show a high incidence (up to 16.3 percent) of abnormal larvae in the presence of detergents (Hart and Fuller, 1979).

Litter is a form of pollution associated with increased boating activity that has an aesthetic as well as an ecological impact. During the peak boating season, approximately one-half to one cubic yard of uncompacted garbage per day can be expected for every 100 boats in a marina (Olsen and Burd, 1982). Plastics are the chief concern. To date, 15 percent of the world's 280 species of sea birds are known to have ingested plastic (Wehle and Coleman, 1983). Plastic has been found in the stomachs of four of the seven species of marine turtles, in at least eight species of fish, in marine mammals including whales, dolphins, and manatees, and in invertebrates. The reason for ingestion of plastic items appears to be related to their similarity in color, size, and shape to natural prey. For example, transparent polyethylene bags evoke the same feeding response in sea turtles as do jellyfish, the major food of leatherback turtles and a secondary food source for green, loggerhead, and other sea turtles (Wehle and Coleman, 1983). In some cases, ingested plastic causes intestinal blockage. It may also reduce animal hunger sensations and thus inhibit feeding, cause stomach and intestinal ulcerations and damage to other anatomical structures, and contribute synthetic chemicals to body tissues causing eggshell thinning, aberrant behavior, or tissue damage. Wildlife also may become entangled in plastic. Lost or discarded fish netting, monofilament line, and plastic beverage yokes are materials that may lead to strangulation, drowning or starvation. Waterborne trash can also affect sensitive mangroves by covering, breaking off, or uprooting seedlings.

Sanitary Wastes from Shoreside Facilities

Much of the coastal development associated with new marinas may occur in localities that are not served by municipal waste collection and treatment systems. As a result, septic tank disposal systems are the predominant type of waste treatment used. A septic tank removes solids, decomposes wastes biologically (anaerobically), and stores scum and sludge (USPHS, 1967b). The efficiency and effectiveness of a tank system is governed by the soil sorption system of a site (Polkowski and Boyle, 1970; Patterson et al., 1971; Bender, 1971). Treatment effectiveness is dependent upon geographical characteristics of the surrounding area, soil permeability, soil depth, groundwater level, slope of the ground surface, proximity to surface waters and presence of fractured geologic strata (Polkowski and Boyle, 1970; Patterson et al., 1971; Bender, 1971; Kingston, 1943; Leopold, 1968).

Failures of septic tank systems are generally due to overloading, characteristics of the soil (either impervious or too pervious soils) or high groundwater levels which prevent proper system functioning (USEPA, 1975b). Any sewage that leaches into marina waters from malfunctioning (poorly designed, sited or maintained) septic systems contributes to the overall coliform bacteria levels of marina waters. The effects of leached fecal contamination are the same as those previously cited for sewage pollution from boats. Additionally, excessive septic tank leachings can cause nuisance plant growth, algal blooms, the creation of anoxic zones in areas with poor hydraulic flushing characteristics, fecal contamination of groundwater, and the presence of offensive odors resulting from organic decomposition (USEPA, 1975b).

Under ideal soil and hydrological conditions, percolation of sewage through several feet of fine saturated soil will effectively remove pathogenic viruses and bacteria (Butler et al., 1954; Robeck et al., 1963). Soil characteristics, area hydrology and rate of sewage input all play important roles in the filtering capabilities of the soil; the amount of soil needed for proper filtering may vary. Soil characteristics may also affect the rate and distance of travel of bacteria through the soil. Bacteria can travel from 10 to 2000 feet; the most common distances reported are 10 to 400 feet (Polkowski and Boyle, 1970; Butler et al., 1954). The rate of chemical transfer through soil is even greater (Butler et al., 1954; Mallman and Mack, 1961). Some enteric viruses in surface waters may take as long as 100 days for inactivation of 99.9 percent of their viral infectivity (USEPA, 1975b). Estimates of the enteric virus content of polluted waters range from 0.15 to 1.5 per 100 ml of water (Clarke et al., 1964); however, these low densities are significant in view of reports that as few as one infective tissue dose may be enough to cause infection (Mechalas et al., 1972; EPA, 1976). Shellfish tend to concentrate enteric pathogens, thereby prolonging their infectivity.

Very few studies of septic systems specifically located at marinas have been conducted. One study (Mack and D'Itri, 1973) concluded that a damaged septic system, along with the raw sewage discharged by boats into a Michigan marina, were responsible for coliform counts being higher at slips most frequently used by boats than at sites remote from the marina. Studies conducted by USEPA (1975b) have shown that septic systems located 50 feet from finger-fill canals transmitted leachates into canal waters in 25 hours at Punta Gorda, Florida and in 4 hours and 60 hours in studies at Atlantic Beach, North Carolina. These areas, which were mostly fill material, had poor soil percolation characteristics. Most Region IV states require drainfields to be at least 50 feet away from surface waters. USEPA (1975b) has recommended that drainage fields be a minimum of 100 feet away from a body of surface water and three to four feet above the saturated soil zone at the wettest time of the year. Leopold (1968) also stated that a setback of at least 100 feet is required for effective cleansing in areas such as coastal soils where groundwater is subject to exchange with surface waters and that, in general, no seepage field should be located closer than 300 feet to a channel or watercourse.

Water quality assessment methods that may be used to predict impacts to shellfish and other aquatic organisms from sedimentation, dredging activities and pollutant loading are detailed in Section 4.2. Monitoring shellfish, grassbed, benthic, and nursery habitats may involve sample collections at regular intervals over periods of time (up to two years in many cases), normally in concert with water quality monitoring. Most of these measurement methods (outlined in Appendix A) are labor intensive or require sophisticated analytical apparatus. Mitigative measures for aquatic habitat resources are described in Sections 5.2.2 and 5.3.2.

Impacts of Boat Operation

Boat operation affects the environment by creating wakes and turbulence and by directly contacting flora and fauna, particularly with propellors. Boat wakes can contribute to shoreline erosion in some locations. An important factor in mangrove establishment and survival, for example, is wave energy from natural waves, currents, and boat wakes at the shoreline. Teas (1980) reports wave action can wash out well-established mangroves. Red mangrove seedlings planted on the east coast of Florida showed a greater survival rate in low energy sites than in areas subjected to waves from boat traffic (Teas, 1980). The degree of impact from boat wakes depends on shoreline soils, topographic conditions, vegetation characteristics, and exposure to natural wave action.

Studies conducted in Anne Arundel County, Maryland to evaluate the impact of boat wakes on shoreline revealed that the majority of shoreline erosion measured was caused by storms and normal wave action (Zabawa and Ostrom, 1980). Boat wake energy measured at five sites varied between

0.5 percent and 9.5 percent of the total wind wave energy over a one-year period. Shoreline erosion was attributed to boat wakes at only one of five sites. The type of shoreline most susceptible to erosion has a combination of the following characteristics (Zabawa and Ostrom, 1980):

- Exposed point of land in a narrow creek or cove
- Shoreline segment consisting of easily erodable material (i.e., sand or gravel)
- Steep nearshore gradient on the shoreline profile
- Location adjacent to a high rate of boating, with boat passage relatively close (two or three hundred feet) to the shoreline.

Wave action also can disturb shellfish such as oyster beds with newly attached spat and can damage fragile shells of the spat, as well as the adult oysters. Boat wake action that increases the energy imparted to the shoreline can result in removal of the fine-grained substrate suitable for oyster habitat (Marshall, 1984). Godwin (1977), who performed a survey of closed shellfish waters in the Intracoastal Waterway and in Brunswick County, North Carolina, found that wake turbulence from vessel traffic was a limiting factor in oyster production. Natural oyster production was low because of wakes created by vessels, lack of oyster cultch material, and soft bottom sediments in the adjacent marsh areas. Breaking waves caused by boat passage were reported to cause the short-term loading of suspended material to increase two orders of magnitude above that of the ambient level at nearshore sites in Anne Arundel County, Maryland (Zabawa and Ostrom, 1980). The increased amount of suspended sediment was attributed to either the bottom sediments in the nearshore, or from the bank scarp within the range of the boat wake's path. Values for total wind and boat-wake energies can be estimated. However, a complete portrayal of the wave energy at a site would require continuous measurement of the waves. The principal steps involved in the calculation of boat-wake energy are (Zabawa and Ostrom, 1980):

1) Develop for each site the regression relationship between hourly boating frequency and total boat-wake energy per hour. This relationship allows the simple estimation of hourly wake energy from the hourly boating frequency

2) Establish the duration of the boating season

3) Establish the average hourly boating frequency for both weekdays and weekends at each site

4) For the purposes of computation, the period of boating activity each day may be estimated as 8 hours

5) Following steps (1) through (4), the wave energy due to boat wakes can then be calculated on a monthly basis.

Lagler et al. (1950) found in experimental pond studies that, although a considerable amount of bottom material was moved by outboard motors in waters less than 30 inches deep, the turbidity was not measurably increased. Lagler et al. (1950) noted that the ponds had muddy bottoms and that turbidity caused by motor operation may be greater where bottom soils are dominantly clay. Beds of aquatic vegetation can minimize the turbulence effects of propeller wash. However, motor boat usage was found to destroy rooted aquatic vegetation in motor paths where the propeller was within 12 inches of the bottom. Lagler et al. (1950) also showed that the number and volume of bottom organisms was substantially reduced in shallow boat paths. This reduction may be due to a variety of reasons, including organisms being washed out of the boat path or tossed into the water column where they were consumed by fish, or destruction by the engine itself.

One of the most serious impacts of boat motors on flora and fauna is direct contact of boats and propellers with the bottom or with animals in the water column. Zieman (1982) stated that the most common form of seagrass bed disturbance in south Florida is cuts from boat propellers. Although it would seem that these small cuts would heal rapidly, Fuss and Kelly (1969) found that 10 months were required for turtle grass (the spatially dominant south Florida species) to show new shoot development. Two to five years were typically required to recolonize a turtle grass bed (Zieman, 1976). Seagrass disturbances in some regions become permanent features. Turtle grass (Thallasia testudinum) has failed to recolonize in many areas in south Florida and the Caribbean even 50 years after its removal. Although scarred areas rapidly fill in with sediment from the surrounding seagrass beds, there is less fine sediment, reduced pH and reduced oxidation-reduction potential in bottom sediments below boat tracks.

Another form of impact occurs when coral is overturned or otherwise physically disrupted. This type of damage is geographically restricted in USEPA Region IV to the Florida Keys, where corals occur. It usually results from careless anchoring, rather than direct contact with boats or motors (Tilmant, 1981). The construction of marinas may make sensitive sites such as seagrass beds and coral reefs more accessible to the public, thereby increasing the possibility of impact.

The largest single mortality factor for manatees, an endangered mammal, is collision with boats and barges. Scars and deformities from being run over by boats are so common and distinctive on manatees that they are used in surveys for recognition of individuals (Brownell, 1980). Manatees may dive to avoid boats if the water is deep enough and the boat is moving slow enough to provide sufficient warning. However, manatees do not necessarily avoid areas with heavy boat traffic (Packard, 1981) and may even become accustomed to the sound of boats (Reynolds, 1981).

Sea turtles also are subject to collision with boats. In the summer, turtles congregate near nesting beaches and during nesting intervals these animals may be found either along shore in the ocean or in the lagoons and estuaries behind the barrier islands (Hopkins and Murphy, 1981; Stoneburner, 1982). It is primarily during the summer nesting period that impact from motor boats occurs.

4.3.2 Terrestrial Habitat

Marina construction may impact terrestrial habitats through grading, clearing and filling of marina areas during construction. The extent of impact is directly related to the size of the area altered. The primary impact from marina construction is the actual physical replacement of terrestrial habitats such as forests and grasslands. Habitat loss can be predicted once marina design, location and size are determined as discussed in Section 3.4.1.

Impacts on adjacent terrestrial habitat can result from upland dredged material disposal and the operational noise and general activity at the marina. Impacts to adjacent protected areas or wildlife management areas depend on the proximity of such areas to the marina site, the organisms present, the schedule for construction and type of construction and boating activities.

Heavy construction equipment and support vessels produce noise. Noise levels from construction of rip-rap revetments, for example (dBA=decibels adjusted to the A-scale compatible with human hearing capabilities), would affect an area of about 100 feet and may disrupt local waterfowl (Mulvihill et al., 1980). Pile driving (101 dBA at 50 feet: Bolt, Beranek, and Newman, Inc., 1971) for docks and piers can temporarily affect terrestrial organisms and vibration-sensitive marine organisms.

The United States Environmental Protection Agency (USEPA, 1978b) indicated in a draft EIS that proposed dredging of the inland Theodore Ship Canal in Mobile, Alabama was expected to produce 85 dBA at 100 feet. Noise sources for the "improvement and extension" of the channel were listed as a 27-inch hydraulic dredge, pump, and tug boat. Since tug boats are often needed to assist dredges or spoil barges, Table 4-19 (excerpted: USEPA, 1978b) is presented to provide additional noise data produced by various tugs/barges. For reference, the average noise level emanating from motorboats at 50 feet is 80 dBA (Berkau, 1975). Table 4-20 (excerpted: Bolt, Beranek, and Newman, Inc., 1971) provides noise level data for construction equipment that may be used in marina construction. Ambient (background) noise levels are important in the assessment of noise impacts since noise in quiet undisturbed areas would have more of an effect than would noise in industrialized coastal areas. Ambient noise levels measured at a shoreline on Dauphin Island, Alabama with light breaking waves, for example, were 55 to 65 dBA (Coastal Ecosystems Management, Inc., 1974). These noise levels, over a 24-hour period, would become 58 to 71 dB (U.S. Army Corps of Engineers, 1982). Values expected in Mobile Bay were as low as 30 dB during "extremely calm" weather and 55 dB during a "moderate breeze" (USACoE, 1982). The USEPA (1978a) recommends an outdoor day/night level (L_{dn}) of 70 dBA for

TABLE 4-19

NOISE LEVELS OF TUG BOATS AND ASSOCIATED BARGES AT 100 FEET FROM CHANNEL[a]

Tug/barge	Noise levels (dBA) L_{10}	L_{50}	L_{90}
Tug alone	49	47	42
Large tug with 4 loaded barges	56	55	54
Small tug with 2 loaded barges	56	54	51
Small tug with empty barges	55	51	51
Large tug pushing barge at dock area	64	62	58

[a] USEPA, 1978b.

NOTE: L_x (L_{10}, L_{50}, L_{90}) indicates the noise level that is exceeded x percent of the time (USEPA, 1978a).

TABLE 4-20

NOISE LEVELS EMITTED FROM CONSTRUCTION EQUIPMENT AT 50 FEET[a]

Equipment	Noise level (dBA)
Earthmoving	
front loader	79
backhoes	85
dozers	80
tractors	80
scrapers	88
graders	85
truck	91
paver	89
Materials Handling	
concrete mixer	85
concrete pump	82
crane	83
derrick	88
Stationary	
pumps	76
generators	78
compressors	81
Impact	
pile drivers	101
jack hammers	88
rock drills	98
pneumatic tools	86
Other	
saws	78
vibrator	76

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[a] Bolt, Beranek and Newman, Inc., 1971.

commercial/industrial land use and 55 dBA for residential/institutional areas. However, since over 40 percent of the U.S. population is exposed to noise emissions over 55 dBA, an interim value of 65 dBA has been established for residential/institutional areas (USACOE, 1980).

Noise emissions from tug boats and dredging activities would not be appreciably attenuated over open estuarine waters, as opposed to vegetated wetlands, since no vegetation or physical barrier would buffer, reflect, or muffle the noise (USEPA, 1978b). The attenuation distance would also vary with weather conditions. Atmospheric inversions could, for example, increase the propagation of sound considerably, particularly over open water, while rainfall, which produces its own noise, would tend to dampen other sounds.

Boating can be detrimental to wildlife populations if boaters intrude into otherwise secluded habitats. Noise levels from outboard motors have been reported to reach 80 decibels at 50 feet (Wurzback and Lampheer, 1973). Batten (1977) stated that several species of waterfowl no longer used a reservoir because of increased boat activity. Harris and Matteson (1975) reported that nesting success in gull and tern colonies was probably reduced by boaters passing or visiting normally secluded colonies on Lake Superior. In the southeastern United States, this type of impact can be especially significant because several bird species potentially affected are designated as rare or endangered. These include the brown pelican, bald eagle, wood stork, least tern, and several others (USFWS, 1977). The effect of noise on wildlife and other animals has been reviewed by the USEPA (1973b). Effects categories involved hearing acuity, masking of auditory signals, behavioral changes, and physiological stress responses. In general, noise can reduce wildlife hearing sensitivity; mask social signals; induce panicking, crowding, and aversive behavior; disrupt breeding and nesting habitats and possibly migration patterns; and change blood pressure/chemistry, hormones, and reproductivity. Some animals have been able to adapt to noise sources and to differentiate dangerous ones from others.

Measurement methods for assessing terrestrial impacts are presented in Appendix A. Many sampling techniques will allow inferences of the areal extent of impact from marina development if monitoring is required. Mitigative measures (Section 5.4.2 and 5.5.2) may be proposed based on the results of impact assessment.

4.3.3 Wetland Habitat

One of the most ecologically important estuarine habitats that may be impacted by marina construction and operation are wetland habitats, specifically salt marshes. Because of their importance, destruction or modification of wetlands for marina development is generally unacceptable.

Saltwater wetlands include the coastal area between the mean low tide mark and the normal high storm water line. Wetlands include the tideflats, vegetated tidelands (salt marshes and mangrove swamps), and wetland areas between the tidelands and the floodplains. This general definition is similar to that reported in Clark (1974), although somewhat more inclusive. Wetlands have also been classified by the U.S. Department of the Interior, Fish and Wildlife Service (Cowardin et al., 1979).

The importance of wetlands and the concept of interrelationships in ecosystems has been reviewed in Odum (1971), Clark (1974), and others. In principle, wetlands are vital areas that serve as a buffer between the estuary and developed upland areas. Drainage from the uplands is therefore cleansed by marsh and mangrove vegetation. According to Clark (1974), a 1,000-acre marsh may be able to filter the nitrogenous wastes of some 20,000 people. Wetlands also slow the drainage from uplands for natural flood control. Salt marshes, such as those in Georgia and South Carolina, and mangrove swamps, found in south Florida, fill an important role in collecting, assimilating, storing, and supplying nutrients to the wetland and contiguous estuary. Nutrients are available in the form of degraded plant material (detritus) and minerals which are important to the food web which microorganisms, plankton, fishes, and man depend. According to Clark (1974), approximately half of the plant material produced by grass marshes and mangrove swamps is flushed to the estuary where it supports the many estuarine inhabitants. In addition to food, wetlands provide habitat, predator protection (cover), and nursery areas for invertebrates, fishes, and various local or migratory birds. These concepts are now well recognized and documented so that alteration of wetlands and disruption of their ecological function is considered detrimental to the environment. Chmura and Ross (1978) suggest that certain aspects of marina development are irreversible since an altered environment "...cannot be restored to its original condition."

Development of marinas in wetland areas can include the removal or covering (dredge spoil filling) of wetland habitat. Dredging new canals or improving existing canals or natural waterways for boat navigation purposes directly impacts the benthic habitat because submerged bottom and benthic macroinvertebrate inhabitants are excavated. Channelization in wetlands for drainage or for providing boat access to shallow water marinas will similarly result in benthic habitat loss.

The physical effects of stream channelization have been reviewed (Virginia State Water Control Board, VSWCB, 1979). Boozer (1979) indicated that straightening channels in wetlands can cause the idle meander sections of the channelized drainage creek to fill with sediment and result in more rapid drainage of a wetland. From an environmental standpoint, increased wetland drainage could be detrimental since it would reduce water filtration and reduce the water level typical of the local wetland and the associated wildlife. However, channelization may, in some instances, be beneficial if tidal flushing is enhanced in areas where water quality is poor due to low flushing rates.

The value of an estuary, which is essentially a shallow marine habitat influenced by freshwater, is related to the value of saltwater wetlands. Estuaries use the nutrients from wetlands and other runoff sources and provide grassbeds used as nursery grounds by the eggs, larvae, and juveniles of various fish and benthic communities. Seagrasses also serve to stabilize and trap suspended sediments (Clark, 1974). Dredge-related destruction of grass flats may increase turbidity levels directly through removal of substrate or indirectly through alteration of the sediment stabilizing and filtering function of seagrasses. Zieman (1982) reports that the primary cause of seagrass bed destruction in south Florida is probably dredging.

As an example of the value of estuaries it has been estimated that in the late 1960's fishery production in the Tampa Bay estuary was worth about $741/ha ($300/acre; Taylor and Salomon, 1968). This estimate increased to $988/ha ($400/acre) when additional consideration was given to the use by public utilities, industry, commerce, and also the recreational use by approximately one million residents and 1.5 million annual tourists. The value in present-day dollars is even higher. For example, in 1976, the Gulf State fisheries were valued at $275.2 million (U.S. Department of Commerce, 1980) compared to 1964 U.S. Fish and Wildlife Service statistics estimating the U.S. Gulf of Mexico commercial fisheries at approximately $114 million per year (Taylor and Saloman, 1968). Loss of productive estuarine habitats, particularly seagrass beds, would reduce fishery recruitment which, in turn, could reduce recreation and marina-related activities.

Habitat Loss

Gross measurements published in 1967 by the U.S. Fish and Wildlife Service (Chapman, 1968) indicated that dredging and filling destroyed over 74,074 ha (200,000 acres) of "shallow bay nursery areas" in the Gulf and south Atlantic between 1948 and 1968. Approximately 389 to 518 km^2 (150 to 200 mi^2) of Florida's marshland, tideland, and estuarine water areas have been lost to dredging and landfills (Krenkel et al., 1976 in Johnston, 1981). Chapman (1968) reported that 20 percent of the surface area of Boca Ciega Bay, Florida, for example, was altered with dredged fill for waterfront real estate purposes. In Florida, 9,520 ha (23,524 acres) of submerged land has been filled with dredge spoil, primarily to form land for residential and industrial purposes (Zieman, 1982).

The U.S. Army Corps of Engineers is responsible for dredging large volumes of sediment each year to maintain navigable waterways. Annual quantities are approximately 206 million cubic meters (400 million cubic yards), with costs exceeding 150 million dollars (Montgomery and Griffis, 1973). Windom (1976) reports that most of this dredging occurs in estuarine areas where major harbors and navigation channels exist. While these figures reflect dredging in general, as opposed to marina-related dredging, they emphasize the potential physical alteration and coastal ecosystem stress associated with dredge and fill operations to which marina development can contribute.

The importance of habitat loss is related to the existing environment at the prospective marina location. Although the effects of turbidity and siltation are associated with alteration of shoreline and submerged bottom sediments in general, the impact is significantly greater when coastal wetland habitats and estuarine seagrass beds and their inhabitants are disturbed, removed, or covered with dredge spoil.

Dredging can affect the tidal area, open water bays, oyster reefs, shallow shoreline zones, beaches, and river deltas (Chapman, 1968). Studies of an oyster shell mining project in Tampa Bay, for example, showed that between 3,500 and 22,000 invertebrates were destroyed for every square meter of dredged bottom (Taylor, 1973). Such data are dependent upon the health of the estuary and the type of habitat disturbed. If commercial benthic species are killed by dredge removal or siltation related to dredging, the cost and socioeconomic repercussions of dredging activities are increased and are more easily recognized. The commercial oyster, primarily Crassostrea virginica in the coastal states of USEPA Region IV, is a valuable fishery resource in several of the coastal states. Data on oyster landings, compiled by the National Marine Fisheries Service (NMFS, unpublished), are presented in Table 4-21 by poundage and total value for 1982 and 1981. The Florida fishery resulted in the highest total value obtained for 1981 and 1982, with Mississippi and Alabama also leading in 1982 and Alabama and South Carolina leading in 1981. The highest 1982 price per pound ($1.48) was calculated for North Carolina oysters and the lowest figure ($0.49) was obtained for South Carolina. Although these landings are valuable to several of the states, they are small when compared to the 1982 landings for neighboring Louisiana, where landings were higher than all of the study area states combined (12,621,484 pounds valued at $17,010,770).

Spoil banks and channels (borrow pits) resulting from dredging can segment an estuary and affect water circulation (Chapman, 1968). Since tides are influenced by estuarine geometry (VSWCB, 1979), tidal flows may be altered by changes in bottom topography. For example, spoil deposition in upper Tampa and Hillsborough Bay (Florida) from channelization activities has adversely affected circulation and tidal exchange rates (Taylor, 1973). Segmentation also may isolate certain areas and cause shoaling, which may reduce the value of these areas as a nursery ground (Chapman, 1968).

Although marina-related dredging activities comprise only a small proportion of total dredging in coastal areas, this dredging may have significant local environmental impact, depending on the proximity to sensitive environmental areas. Dredging may be necessary during marina construction to provide safe access channels and to maintain acceptable water quality within marina basins. The importance of good water circulation has been stressed by several authors (Chmura and Ross, 1978; Boozer, 1979; USEPA, 1975b). A flushing turnover rate of two to four days has been recommended (Boozer, 1979). Flushing is a function of channel depth. USEPA (1975b) has recommended an optimum depth of four to six feet at mean low water in order to maximize canal flushing, meet

TABLE 4-21

1982 AND 1981 OYSTER LANDINGS PRESENTED BY STATE AND RANKED BY TOTAL VALUE[a]

State	Value	Pounds	Price/pound
		1982	
Florida	$5,420,520	5,236,186	$1.04
Mississippi	2,237,683	2,575,970	0.87
Alabama	2,150,500	1,496,949	1.44
North Carolina	908,676	611,998	1.48
South Carolina	797,649	1,612,451	0.49
Georgia	24,016	18,292	1.31
TOTAL	$11,539,044	11,551,846	$1.00
		1981	
Florida	7,177,315	7,269,384	0.99
Alabama	2,002,392	1,329,925	1.51
South Carolina	1,378,224	1,467,254	0.94
North Carolina	730,293	550,502	1.32
Mississippi	472,729	467,070	1.01
Georgia	35,716	24,898	1.43
TOTAL	$11,796,669	11,109,033	$1.06

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[a] National Marine Fisheries Service, Unpublished.

navigational requirements and minimize the potential for violations of state dissolved oxygen standards.

While dredging activities may result in potentially adverse ecological effects in terms of habitat loss, fishery potential reduction, and circulation disruption, some positive effects can also result. Dredging can increase circulation, which may be beneficial for marina basin water quality and aesthetics. Certain isolated or brackish/freshwater areas also may become open to estuarine circulation and could become productive nursery grounds. This may serve as partial compensation for the direct loss of habitat (Chapman, 1968) unless saltwater intrusion progresses too far inland, causing freshwater aquatic vegetation to die. The habitat loss from marina construction is also lessened by the colonization of new surface areas provided by marina structures, particularly rip-rap and piling surface areas (Boozer, 1979). Algae and benthic invertebrates that live on these surface areas may serve as fish forage. Although these communities do not replace lost wetlands (Boozer, 1979), they can lessen the impact. Conversely, undesirable blue-green algae may repopulate a new surface area. This may be detrimental if toxins are released during blue-green algal blooms. Resuspension of nutrients during dredging can be useful in providing needed nutrients to phytoplankton and other vegetation (Chapman, 1968), although these nutrients may contribute to detrimental algal blooms. Dredging may provide a temporary food source for turbidity-tolerant fishes, crabs, and shrimp that forage on the benthic animals discharged with dredge effluent at spoil sites (Taylor, 1973). Other benthos may be exposed and become accessible at dredge sites during sediment disruption. Finally, dredge spoil is sometimes suitable for use as beach nourishment or as sand or gravel for construction, and can be used to establish new salt marshes or islands (USACOE, 1975; Chmura and Ross, 1978). For example, Oyster Bed Island in Georgia (Tybee National Wildlife Refuge), a marsh island in the Savannah River that has been used for spoil disposal for years, provides habitat for gulls, terns, shore birds, and wading birds (Johnson et al., 1974).

Habitat Modification

Dredging impacts should be assessed holistically, so that all species and all life stages are considered as part of an interrelated community system. Species of particular concern are those that are of commercial, recreational or aesthetic value, geographically restricted, sensitive or protected. Their food supply network and habitat vegetation also are factors of concern. Non-motile species/life stages such as sessile (attached) benthic animals, drifting plankton, and the eggs and larvae of fishes and invertebrates are particularly subject to dredging impacts such as siltation since they cannot avoid areas of high turbidity. Loss of seagrass, wetland, reef, and other habitats on which organisms depend may also damage existing populations and hinder or preclude the survival and subsequent recruitment of organisms.

Turbidity

The effect of turbidity on aquatic/marine animals is related to the composition and concentration of the suspended solids, the toxins adsorbed (if any) on the suspensions, and the tolerance, age, health, and stress load of the organisms at the time of impact (Stern and Stickle, 1978).

Molluscs such as oysters, clams, and mussels are filter feeders and, thereby, cleanse the water and reduce turbidity. Studies reviewed by Stern and Stickle (1978) have shown that mortality of molluscs is low in areas near dredging unless they are buried by sediment at disposal sites. However, Johnston (1981) reported that oysters within the immediate vicinity of a commercial hydraulic clam dredge died, and a significant number of oysters within 25 feet also died.

Filter-feeding invertebrates also can be affected by turbidity (Stern and Stickle, 1978). In the presence of an increased level of suspended solids, the energy expended in food gathering may exceed the energy obtained from the food ingested, water transport rate and filtering efficiency can be affected, and the amount of energy required for maintenance may increase due to turbidity stress. Oyster growth may be decreased by reduced pumping rates caused by high levels of suspended solids (Johnston, 1981). In addition, the capability to combat any additional stress may be decreased.

The effects of turbidity are usually not permanent (Stern and Stickle, 1978). Normal mollusc pumping rates, for example, usually followed the return of natural conditions. Dredge-resuspended pollutants may have a long-term effect on commercial species such as oysters, since these species concentrate pollutants and then are consumed by man.

Corals are usually harmed by increases in turbidity and suspended solids (Stern and Stickle, 1978; Hirsch et al., 1978; Johnston, 1981). Coral feeding activity is reduced and decreased light penetration affects photosynthetic coralline algae. High turbidity and sedimentation may decrease coral abundance, alter growth forms, and decrease coral species diversity.

Laboratory studies reveal that fish egg development is delayed for several hours by suspended solids and mollusc eggs and larvae development are also affected (Stern and Stickle, 1978). Increased amounts of particles in suspension may kill pelagic and recently settled larvae (Rosenberg, 1977). However, resuspended detritus may also provide nutrient material and protection from predation for transient estuarine biota (Sherk, 1971 in Johnston, 1981). Taylor (1973) reported that researchers studying Boca Ciega Bay in Florida showed that turbidity created by dredging may benefit certain suspension and deposit feeding invertebrates (sponge, echinoderm, and ascidean). The benefit is apparently related to increased availability of food in the form of invertebrates' remains in dredge effluent. However, ingestion of resuspended pollutants may be harmful to suspension and deposit feeders or their predators, as indicated by increased heavy metal concentrations in benthic fauna of a Swedish estuary after dredging (Rosenberg, 1977).

Although adult fish are more sensitive to suspended solids than most invertebrates, they are motile and presumably can escape turbidity plumes (Stern and Stickle, 1978). No effects from dredging were found on the highly motile fishes and invertebrates studied during dredging of the Georgia Intracoastal Waterway (Stickney, 1972). However, it is likely that some bottom-dwelling species, such as flounders, would be susceptible to dredging activities. Since predatory game fish are known to be visual feeders (Clark, 1974), their feeding behavior also may be affected by turbid water. Everhart and Duchrow (1970 in Johnston, 1981) reported that fish may be more susceptible to invasion by parasites or disease due to removal of protective mucus by coarse particles in suspension. Fish can suffocate from clogged gill filaments if the level of suspended materials is high. Johnston (1981) reported that fishes near an active dredge site swam less, showed modified social dominance patterns, and engaged in "coughing" and gill scraping behavior in an attempt to free their gills of accumulated particulate matter. The resuspension of bottom material by dredging operations during warm months, particularly during times of maximum fish migration, may be lethal to many forms of aquatic life (Brown and Clark, 1968).

The variability of biological field studies makes it difficult to assess the effects of dredging on zooplankton populations. For this reason, the few studies that have been conducted were done in the laboratory. For example, copepod zooplankton response to suspended solids was studied by Sherk et al. (1976). When presented with phytoplankton food in the presence of sediment suspensions, copepods showed reduced phytoplankton uptake, apparently due to non-selective ingestion of all particles, including sediment. Such indiscriminant feeding could ultimately become important since less food and energy is being obtained. The concentration ratio of suspended solids to phytoplankton was also important.

Turbidity generally reduces the amount of sunlight that is transmitted through the water column, which decreases the depth of the euphotic zone within which photosynthesis occurs in vegetation such as seagrasses and phytoplankton. Reduced plant photosynthesis results in less growth (primary production or carbon assimilation), less plant production of dissolved oxygen required for most life and lower relative abundance of phytoplankton, which is an important component in the marine food chain.

Laboratory tests have shown that three common phytoplankton species, including Chlorella, exhibit a 50 to 90 percent reduction in carbon assimilation with the addition of fine silica sand to cultures (Sherk et al., 1976). It was assumed that this reduction was associated with light attenuation caused by the added silica suspensions. Similar conclusions have been reported regarding turbidity and reduced phytoplankton productivity for a field study conducted in Chesapeake Bay (Harrison and

Chisholm, 1974). Zieman (1982) reported a decline in primary productivity for seagrass (turtle grass) in Texas, apparently due to stress related to suspended silts. However, the following year the seagrass showed increased growth, possibly attributable to nutrients resuspended by dredging the previous year. In the Caribbean, turtle grass stands declined as a result of turbidity or siltation from dredging. Turtle grass once found at depths up to 33 feet became restricted to areas of eight feet or less, apparently due to increased turbidity.

Siltation

The effects of siltation on aquatic/marine fauna and flora are generally more serious than the effects of turbidity. The immediate effects of siltation include the death of organisms due to suffocation, which results in a reduction in faunal biomass and number of species and individuals (Kaplan et al., 1975 in Johnston, 1981). Long exposure to sedimentation may lead to the elimination of many desirable species of plants and animals (Sherk, 1971 in Johnston, 1981). Siltation caused by dredging and filling can affect fish by reducing or eliminating food supplies, destroying habitat including spawning areas, and smothering eggs and larvae (USEPA, 1976 in Johnston, 1981). Van Dolah et al. (1979) studied the effects of unconfined disposal of dredged material in Sewee Bay, South Carolina and concluded that benthic effects were "short term and isolated." This summary, however, did not agree with the work of several other authors reviewed by Van Dolah et al. (1979) who showed the adverse effects of benthic smothering before spoil recolonization occurred. Van Dolah et al. (1979) attributed the Sewee Bay results to the use of several disposal sites as opposed to one, which resulted in a more even distribution. Additional favorable factors included good site flushing patterns, presence of resistant and common species, a similarity between the spoil material and the existing disposal area sediments, and favorable seasonal effects.

Although sessile organisms attached to bottom substrate can easily be killed by burial, some non-sessile benthic forms are able to burrow or otherwise emerge from sediment burial of up to 21 cm (8.3 inches; Chmura and Ross, 1978). Laboratory studies have shown that vertical migration of motile invertebrates was possible if the sediment characteristics of the deposition layer were similar to existing habitat sediment (Hirsch et al., 1978). However, an overburden of mud on sandy bottom or the reverse could be detrimental to organisms. Reimold et al. (1978) performed field experiments to study the recovery of marsh snails, crabs (e.g., fiddler), and vegetation (Spartina alterniflora) subsequent to overlaying with unconsolidated sand, silty sand, or clay overburden at depths ranging from 8 to 91 cm (3.2 to 35.8 inches). A summary of the relative success of plant and animal recoveries under the experimental conditions is presented in Table 4-22 (excerpted: Reimold et al., 1978). In general, organisms buried under up to 23 cm (9.1 inches) of sediment showed "average" to "excellent" recovery, as well as some "poor" recoveries. A study in Card Sound near Biscayne Bay, Florida showed that turtle grass can survive a light cover of dredge sediment of up to 10 cm (4 inches) if

TABLE 4-22

A SUMMARY OF THE RELATIVE SUCCESS OF MARSH PLANT AND ANIMAL RECOVERIES FOLLOWING SEDIMENT BURIAL TO SEVERAL DEPTHS[a]

Unconsolidated depth of material	Sand			Silty sand			Clay		
	Feb fill	July fill	Nov fill	Feb fill	July fill	Nov fill	Feb fill	July fill	Nov fill
8 cm	PR= 4 SR= 4 CR= 3	PR= 4 SR= 3 CR= 3	PR= 4 SR= 2 CR= 3	PR= 4 SR= 4 CR= 3	PR= 4 SR= 4 CR= 3	PR= 4 SR= 2 CR= 3	PR= 4 SR= 4 CR= 4	PR= 4 SR= 3 CR= 4	PR= 4 SR= 2 CR= 4
15 cm	PR= 4 SR= 4 CR= 2	PR= 4 SR= 3 CR= 2	PR= 4 SR= 1 CR= 2	PR= 4 SR= 4 CR= 2	PR= 4 SR= 2 CR= 2	PR= 4 SR= 2 CR= 2	PR= 4 SR= 4 CR= 4	PR= 4 SR= 2 CR= 4	PR= 4 SR= 1 CR= 3
23 cm	PR= 4 SR= 2 CR= 1	PR= 4 SR= 2 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 2 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 1 CR= 1	PR= 4 SR= 2 CR= 3	PR= 4 SR= 2 CR= 4	PR= 4 SR= 1 CR= 4
30 cm	PR= 3 SR= 0 CR= 1	PR= 3 SR= 1 CR= 1	PR= 2 SR= 1 CR= 1	PR= 3 SR= 2 CR= 1	PR= 2 SR= 1 CR= 1	PR= 3 SR= 1 CR= 1	PR= 3 SR= 2 CR= 2	PR= 2 SR= 1 CR= 2	PR= 2 SR= 1 CR= 2
61 cm	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 1	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 1	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0
91 cm	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 1	PR= 1 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 0 SR= 0 CR= 0	PR= 1 SR= 0 CR= 0

[a] Reimold et al., 1978.

PR = Plant recovery
SR = Snail recovery
CR = Crab recovery

4 = Excellent
3 = Good
2 = Average
1 = Poor
0 = No recovery

the root (rhizome) system is not damaged. Although leaf material was killed, regrowth occurred after dredging ceased and currents removed the siltation (Zieman, 1982).

Siltation can also reduce the dissolved oxygen in sediment habitats since the interstitial water circulation is reduced, particularly if fine silt or clay particles are deposited (Clark, 1974). Clay usually settles out of suspension slowly and may form deposits far from dredging sites.

An example of dredge-related siltation and its effects on the environment was reported by Marshall (1967). The dredge and fill work occurred in Hillsborough Bay, Florida. Despite the U.S. Army Corps of Engineers' stipulation for dike construction around the bayfill area, a section of the dike was not completed until considerable siltation had occurred through the remaining gap in the dike. Marshall (1967) reported that the silt was up to approximately two feet deep and had spread several thousand feet outside of the dike gap. Extensive areas of grassbeds and oyster bars were buried with mud and two bird sanctuaries were affected by mud deposition.

Siltation or removal of grassbeds and other important habitats can destroy eggs, larvae, and juvenile fauna that cannot escape the impact and/or use the area as nursery habitat. Species that might be affected include crustaceans (crabs, shrimp, lobster), molluscs (oysters, clams, mussels), estuarine fishes, coelenterates (corals), polychaete worms, sponges and echinoderms (starfish). Tolerance capabilities are specific to species, life stage, and individual. Dredge siltation can also affect the distribution of seagrasses, since the fine sediment muds deposited are often unstable and, consequently, not suitable for seagrass colonization. Taylor (1973) reports that the reestablishment of seagrasses in dredged zones is particularly slow.

Dredged areas and dredge spoil are rapidly recolonized by invertebrate fauna (Taylor, 1973). However, the new communities are often different from the original population. Dredging of deep channels, for example, creates an environment that differs in water depth and light penetration and possibly currents and salinity. Sediment type may also be different, particularly since channels are sinks for silt and other fine sediments. It is documented that species diversity, abundance, and feeding behavior are associated with sediment structure (Taylor, 1973) and that the larvae of many benthic animals will not metamorphose from a planktonic to a benthic form unless contact is made with the appropriate sediment composition (Taylor and Saloman, 1968). Channelization of streams can reduce species abundance and diversity (VSWCB, 1979) and dredging of estuaries can have a similar effect (Rosenberg, 1977). Recovery can occur but may take a long period, such as the two years suggested by Taylor (1973). Taylor and Saloman (1968) reported that the soft deposits of dredged canals in Boca Ciega Bay (Florida) showed only "negligible" recolonization after 10 years. Fish diversity in these canals was also less than at outside stations, and the species present were not bottom types. Changes in populations, however, may not necessarily be detrimental. The canals studied by Taylor and Saloman (1968) did support a 30 percent greater abundance of fish than outside stations. Such changes could result in the attraction and concentration of sport fishes, making them more readily available to fishermen.

Windom (1976) concludes that recolonization can be expected to take place if sediments in a dredged channel or a spoil disposal site are similar in physical and chemical characteristics before and after dredging. Recolonization is less likely to occur if the sediment characteristics subsequent to the dredging operation are considerably altered. The rate of recolonization is dependent on the characteristics of the given locality.

Shoreline structure-related alterations in the physical environment and in the water quality of wetland and estuarine areas can affect local turbidity, sunlight penetration, siltation/erosion, community structure, habitat, air quality and noise levels. The effects of most of these impacts on wildlife were reviewed in Mulvihill et al. (1980) with regard to shoreline structures.

Water-related construction such as pile driving and bulkhead construction produces some turbidity. Turbid waters may affect animal respiration (particularly filter feeders), make resuspended heavy metals and nutrients available from the sediments, and reduce the transmittance of light through the water column, which consequently decreases algal, seagrass, and phytoplankton photosynthesis and dissolved oxygen production. Photosynthetic processes also can be reduced by shading from docks, piers, and covered boat slips constructed over water, or onshore structures that cast shadows over the water.

Siltation and erosion may result from the construction and presence of shoreline structures. Siltation can have a serious impact on seagrasses and sessile organisms and erosion can contribute to turbidity. Newly created habitats formed by changes in circulation and the resultant sediment redistribution often have different sediment compositions and water depths as compared to the original habitat. Since benthic assemblages are associated with particular bottom substrates (Saloman and Taylor, 1968), the organisms colonizing the new habitat may be different in terms of species composition. Such changes in distribution, abundance, and diversity can be beneficial or negative (Mulvihill et al., 1980). For instance, an eroded area downcoast of a groin or jetty may continue to support benthic species following erosion (although probably different and fewer species) but may now have become a favorable habitat for deeper water fishes as well. However, if commercial species are displaced by non-commercial species, the species replacement would not generally be considered beneficial. Mulvihill, et al. (1980) observed that siltation of an oyster bed occurred after the construction of a shoreline structure and the subsequent alterations in current patterns.

The placement of a shoreline structure in an estuarine environment can result in habitat loss due to construction and/or consequences subsequent to placement. Habitat loss may be direct and immediate or indirect and subtle. Dredging of grassbeds and covering wetlands with spoil to backfill bulkheads are examples of direct and immediate loss of habitat for terrestrial and marine life. In addition to the understood value of wetlands and estuarine seagrasses, Mulvihill et al. (1980) reported that the transitional shoreline area between the intertidal and subtidal zones is the most productive zone of estuaries. If bulkheads are constructed below the mean high tide mark they can destroy much of the intertidal zone and eliminate the transitional zone habitat. Loss of habitat also can be caused by bulkhead construction through the shallow water areas needed for marine juveniles to escape larger predators (Chmura and Ross, 1978; Mulvihill et al., 1980) and for nursery areas (see Figure 4-6). Vertical bulkheads, which reflect waves off of their facing, can erode the foreshore, destroying existing grassbeds and preventing their reestablishment. In addition, the obstruction of wetland detrital nutrient flow by backfilling bulkheads often results in decreased productivity in an estuary or local embayment. Studies reported by Mulvihill et al. (1980) in West Bay, Texas showed that the settling rate of oysters was 14 times greater and growth rates were higher in a natural dead-end bayou than in a dredged, bulkheaded canal. Shrimp were studied in natural estuaries and bulkheaded areas and it was found that natural habitats were more productive, partly because of a greater abundance of detritus. Conversely, a finger canal development area in Florida exhibited relatively high productivity, although the productivity may have been enhanced by nearby marshes and tidal action.

While construction and placement of structures can alter the natural environment, the addition of structures can also provide habitat that can be beneficial in less productive environments. Structures can act as artificial reefs and supply substrate for animal colonization. Jetties, rip-rap revetments, and rip-rap breakwaters are good examples because they have considerable surface area and irregular, articulated facings that can serve as cover for sessile, motile, and cryptic species. Resident algal and animal populations also attract grazing and foraging fishes, while above-water rock formations attract waterfowl aggregations. Rock and tetrapod revetments protecting a manmade island off of California (Rincon Island) supported over 225 species of plants and animals. By comparison, mainland sandy beaches provided habitat for less than 12 species and the pre-construction species composition in the island area was only 20 to 25 species (Mulvihill, et al., 1980). A jetty population can be diverse because salinity and current conditions can differ on opposite sides of a jetty (channel versus estuarine side). Similarly, different current and wave regimes typically exist on the outside and lee side of a breakwater and this results in a correspondingly different set of species with different ecological requirements, tolerances, and preferences.

Structures such as bulkheads, pilings and poured concrete revetments provide only minimal habitat because they are vertical, smooth surfaced, chemically treated, and/or have a relatively small surface area. However, most available substrates will be quickly populated in healthy aquatic systems. Encrusting forms such as barnacles are likely marine colonizers of pilings, boat hulls, and bulkheads. Many of these fouling organisms can be used as food by marine organisms (Boozer, 1979).

All marine species that inhabit shoreline structures may not be desirable to marinas. These include insects, borers, isopod crustaceans, and possibly sea urchin echinoderms that can, together with general decay or corrosion, destroy structures. Specific examples listed by Mulvihill et al. (1980) include gribbles (*Limnoria*) and shipworms (*Teredo*). Shipworms made an untreated pine woodwork trestle in Florida unsafe for work within only three months (Mulvihill et al., 1980). Attempts to retard the settling of shipworms and other organisms on the submerged portions of structures usually include chemically treating surfaces with creosote, copper derivations and other chemicals. These substances can leach into marine waters and affect local non-target organisms. Laboratory tests on non-target organisms have shown that creosote, for example, was "moderately toxic" by the USEPA standards for bluegills (990 ppb) and rainbow trout (880 ppb; Chmura and Ross, 1978). Hart and Fuller (1979) reported that, although creosote contains a carcinogen, benzo µaß pyrene, this chemical was not found in mussels attached to pilings treated with creosote. Experiments with copper revealed that certain larval stages of pink and brown shrimp could not tolerate a copper concentration of 0.05 mg/liter in a seawater/brine medium (similar to desalination plant mixtures) but grew normally at a copper concentration of 0.025 mg/l in a 35 ppt seawater medium (Hart and Fuller, 1979). Copper contamination is usually not a problem at marinas if flushing is adequate (Boozer, 1979).

Essential to the establishment, growth, and maintenance of a wetland community are the chemical and physical composition of sediments and water. Dredging, structures, hydrographic modifications, runoff, and boat operation associated with a marina facility and the surrounding area can affect wetland vegetation, soils and erosion rates. Methods for estimating pollutant concentration (Section 4.2) may be used to assess potential impacts to wetland flora and fauna. The impact of boat wakes is addressed in Section 4.3. The predictive methods previously described for water quality and aquatic habitat also may be used to interpret impacts to wetland habitat resources. Mitigative measures for addressing these impacts are described in Sections 5.4.2 and 5.5.2. Sampling techniques and measurement methods for characterizing and monitoring a wetland system are listed in Appendix A.

4.3.4 Protected Species

The principal means of predicting impacts to protected species is the identification of their presence at or near the marina. State and federal lists of endangered species may be reviewed in order to determine potential presence of these species at a chosen marina site. Local experts, U.S. Fish and Wildlife Service and state natural resource agencies may also be contacted for endangered, threatened or rare species information (Appendix F).

Birds are the primary group of endangered species that may be of concern. Manatees and sea turtles also are protected at both state and federal levels. Marinas proposed in locations near rookery areas, manatee refuges or sea turtle nesting areas would be discouraged. Several natural and artificial warm-water refuges for manatees have been designated in Florida (Figure 4-11). While Florida is essentially the northern range of the West Indian manatee, sightings from as far north as Virginia and as far west as Texas have been reported. There have been frequent sightings in North Carolina and Georgia during the summer months (Husar, 1977; Hartman, 1979). There are five species of threatened or endangered sea turtles indigenous to the Southeast, but the loggerhead (Caretta caretta) is the most common (Table 4-23). Sea turtles are generally observed as they come ashore for nesting on open beaches. They are rarely seen inside estuaries where marinas are most likely located; however, these species may suffer secondary affects from boating activity associated with marina facilities. Potential mitigative measures for sea turtles and other protected species are discussed in Sections 5.4.2 and 5.5.2.

4.4 Other Impacts

4.4.1 Historical or Archaeological Resources

Important planning considerations for any proposed marina facility include evaluation of the cultural, economic and environmental consequences of its development. Consideration of the potential effects from marina development on local cultural resources may include the evaluation of historical and archaeological sites. If these sites occur in the area to be developed, data recovery and preservation activities may be necessary to avoid alteration or loss of prehistoric, historic or archaeological resources. Cultural resource measurement techniques are listed in Appendix A.

The National Register of Historic Places, compiled by the National Park Service, may be used as a primary information source for determining whether or not a proposed marina would affect any historic or archaeological site of significance for the area. The Register and the appropriate State Historic Preservation Officer (Appendix F) will provide information on sites that the states are nominating for inclusion, or are considered eligible for inclusion in the National Register. If historical or archaeological resources, including marine artifacts, may be

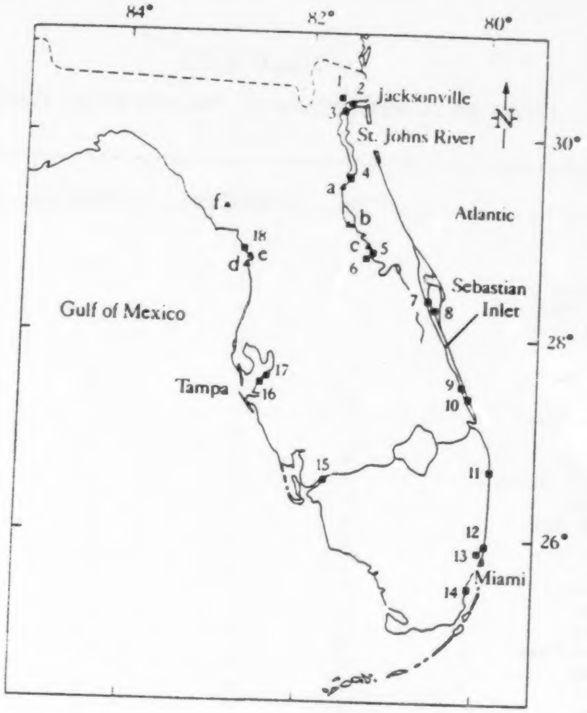

Figure 4-11. Refuges used by the West Indian manatee. Natural warm-water areas are indicated by the triangles: a)Welaka Spring, b) Silver Glen Spring Run, c)Blue Spring Run, d)headwaters of Homosassa River, e)headwaters of Crystal River, and f)Manatee Springs. Artificial warm-water areas are indicated by the squares: 1)Alton Box Factory, Jacksonville, 2)John D. Kennedy Generating Station, Jacksonville, 3)Southside Generating Plant, Jacksonville, 4)Palatka/Putnam Plants, East Palatka, 5)Turner Generating Plant, Enterprise, 6)Sanford Plant, DeBary, 7) Indian River Plant, Delespine, 8)Cape Canaveral Plant, Frontenac, 9)Vero Beach Municipal Power Plant, Vero Beach, 10)Henry D. King Municipal Electric Station, Ft. Pierce, 11)Riviera Plant, Riviera Beach, 12)Port Everglades Plant, Ft. Lauderdale, 13) Lauderdale Plant, Dania, 14)Cutler Plant, Miami, 15)Ft. Myers Plant, Tice, 16)Big Bend Generating Plant, Apollo Beach, 17) Phosphate Plant, Gibsonton, and 18)Crystal River Plant, Crystal River. The Turner Generating Plant, the Palatka/Putnam Plants, the Sanford Plant, and the Cutler Plant are used only occasionally by manatees. Some of these areas have been designated as "Manatee Sanctuaries" by the Florida Legislature. Boat speed regulations are enforced in these official areas. (FPL, 1982).

TABLE 4-23

LOCATIONS IN USEPA REGION IV UTILIZED BY SEA TURTLES[a]

Location	Green	Loggerhead	Hawksbill	Kemp's Ridley	Leatherback
FLORIDA					
St. Josephs Bay		x			
St. Vincent Island		x			x
St. George Island		x			
Dog Island		x			
St. Joseph Sound	x	x	x	x	
Clearwater	x	x	x	x	
Indian Rocks Beach	x	x	x	x	
Johns Pass	x	x	x	x	
Boca Ciega Bay	x	x	x	x	
Pass-a-grille Channel	x	x	x	x	
Old Tampa Bay	x	x	x	x	
Hillsborough Bay	x	x	x	x	
Tampa Bay	x	x	x	x	
Passage Key	x	x	x	x	
Longboat Pass	x	x	x	x	
Longboat Key		x	x		
Sarasota Bay	x	x	x	x	
Big Sarasota Pass	x	x	x	x	
Blackburn Bay		x			
Venice Inlet	x	x	x	x	
Manasota Key	x	x	x	x	
Stump Pass	x	x	x	x	
Charlotte Harbor	x	x	x	x	
Cayo Costa		x			
Sanibel Island		x			
San Carlos Bay	x	x	x	x	
Delnor-Wiggins Pass S.P.		x			
Rabbit Key		x			
Pavilion Key		x			
Cape Sable		x			
Naples		x			
Florida Bay	x	x	x	x	
Hallandale		x	x		
Ft. Lauderdale	x	x			
Lauderdale-by-the-Sea	x	x			
Boca Raton	x	x			x
Lake Worth		x			
Juno Beach	x	x			
Jupiter Island	x	x			
Hutchinson Island	x	x			
Indian River Shores	x	x			
Ballard Pines	x	x			
Satellite Beach	x	x			
Kennedy Space Center	x	x			
Cedar Island	x	x			
Ponce de Leon Inlet	x	x			
Flagler Beach S.P.		x			
Washington Oaks Gardens S.P.		x			
Anastasia Island		x			
Usinas Beach		x			
Palm Valley		x			
Little Talbot Island		x			
Amelia Island		x			
GEORGIA					
Cumberland Island		x			
Jekyll Island		x			
St. Simons Island		x			
Sapelo Island		x			
St. Catherines Island		x			
Ossabaw Island		x			
Wassaw Island		x			
Savannah Beach		x			

TABLE 4-23
(continued)
LOCATIONS IN USEPA REGION IV UTILIZED BY SEA TURTLES[a]

Location	Green	Loggerhead	Hawksbill	Kemp's Ridley	Leatherback
SOUTH CAROLINA					
Hilton Head		x			
Bay Point Island		x			
Pritchard's Island		x			
Fripp's Island		x			
Otter Island		x			
Edisto Island		x			
Kiawah Island		x			
Stono Inlet		x			
Folly Island		x			
Isle of Palms		x			
Dewees Island		x			
Capers Island		x			
Cape Romain		x			
North Island		x			
NORTH CAROLINA					
Long Beach		x			
Cape Fear		x			
Masonboro Inlet		x			
Wrightsville Beach		x			
Mason Inlet		x			
Old Topsail Inlet		x			
Ashe Island		x			
Onslow Beach		x			
Bear Inlet		x			
Bogue Banks		x			
Shackleford Banks		x			
Core Banks		x			
Ocracoke Island		x			
Hatteras Island		x			

[a] From Beccasio, 1980; 1982.

potentially affected by the project, a survey may be justified (Willey, 1966). The survey may include literature, archival, and historical research. Local collectors and other resources may be consulted to determine the possible significance of the site. A surface reconnaissance may also indicate the archaeological significance of a site. Visual analysis may help determine the need for any excavation or laboratory analyses of survey or excavation findings. If the proposed marina site is in a location of known historical or archaeological value, it may be necessary to consider mitigative measures such as those discussed in Section 5.4.3.

4.4.2 Navigation

Potential impacts to navigation resources may result from obstructing boating traffic through structure placement or increased shoaling as a result of marina development. Predicting impacts from structure placement principally involves determining structure requirements for the marina layout and comparing these requirements with the size and type of boats presently using the waterway. Areas of increased shoaling can be predicted from methods discussed in Section 4.2.2. Measurement methods that may be appropriate for assessing existing hydrographic conditions are listed in Appendix A. Mitigative measures for potential impacts are discussed in Section 5.4.3.

4.5 Impact Assessment

Addressing potential impacts from the development and operation of marinas in the coastal zone necessitates a concise and current knowledge of biological interactions, water chemistry, hydrology, geology, engineering practices and the economics of the situation. This chapter has focused on the primary environmental impacts associated with development and operation of marinas in coastal waters by means of reviewing potential impacts and ecosystem perturbations and examining documented physical, chemical, and biological responses to these impacts. Assessment of these impacts may be carried out on multiple levels, each varying in terms of cost and applicability. Responsibility for performing the impact assessment can also vary from decision-making agencies to the developer or third party contractor.

The development of new concepts and methods for evaluating and describing ecological responses to environmental alteration is a dynamic process. This section describes current impact assessment techniques that may be applied on a general basis and a variety of techniques that are impact specific (e.g., dredge and spoil disposal, shoreline and protective structures, sewage pollution and runoff, and boating). There are many other valuable approaches documented by several government agencies that are available for further information (USEPA, USACOE, USFWS, et al.).

4.5.1 Approach

A major public policy concern is for resolving conflicts between environmental protection and coastal development. There are a variety of programs such as characterization studies, baseline studies, and monitoring programs that are justifiably necessary to provide understandings which can help minimize environmental impacts of marina developments and reconcile the conflict between environmental protection and development. The methods of assessing marina impacts are as varied as the impacts themselves. A complete environmental impact assessment consists of the following elements:

1) Initial evaluation
2) Study design
3) Baseline studies and monitoring programs
4) Specific concerns.

Many projects may not require the complete assessment outlined above. The significance of potential problems will dictate the level of impact assessment that is justified. This section presents an overview of environemntal impact assessment.

Initial Evaluation and Ecological Characterization

The level of effort applied in assessing impacts is often limited by monetary constraints. As an early step in the environmental assessment process, efforts to understand the most salient and sensitive components of the ecosystem will facilitate subsequent impact projections. An ecological characterization will provide an initial basis for predicting some of the anticipated impacts of marina development (as discussed in the previous chapters) if they are not already discernible. The USFWS has completed many ecological characterizations and ecological inventories (Gulf and Atlantic Coasts) that may provide a useful foundation of information (Beccasio et al., 1980, 1982, USFWS, 1979a, 1980b-f). In some cases, field reconnaissance may be valuable in completing an initial characterization.

The emphasis of initial evaluation is to provide a basis for further investigation when necessary. Compilation, analysis and synthesis of available and relevant data will establish priorities for future work, given the availability of funding and time. Several resources derived from individual state files may be utilized for quantitative data, including state water quality monitoring data reports, shellfish surveys and data submitted as part of permit applications or to meet permit conditions. These measures are not necessarily project specific, but can be compiled and analyzed and made available for general use.

Other sources of information include existing literature reviews, the use of models, field studies, and/or laboratory research. The Coastal Marinas Handbook, for example, provides guidance for identifying and evaluating potential problem areas associated with marina development and boat operation. When a particular area of concern requires further research, literature reviews can indicate if relevant studies have been conducted previously on the subject matter of concern or in the general geographic area of concern. For example, an annotated compilation of government-funded dredge-related research available through NTIS (National Technical Information Services: Springfield, VA) is presented in Herner and Company (1980). There is limited quantitative information specific to marinas and marina-related impacts. This Handbook may serve as a basis for indicating where further research is needed. Literature reviews can be expedited through contacting private/university organizations that provide a computer search or through government services such as NTIS. Annotated bibliographies and abstracts are also helpful.

Ideally, the initial evaluation and ecological characterization would provide the manager/decision-maker with the information necessary to define the impact assessment objectives. Literature reviews may be supplemented by field surveys or field studies, increasing costs. Responsibility for these costs may be borne by the permitting agency, by the developer, or through other means. Government agencies, universities, and environmental consulting firms can be helpful in providing literature and information relative to the planning or conducting of field and laboratory studies. Examples of information sources are presented in Table 4-24. Limiting studies to relevant data collection for areas of critical concern will reduce costs, save time and provide data most appropriate to specific needs. Models are another predictive tool that can be utilized. Both mathematical modeling and ecosystem simulation can help evaluate assumptions and determine data needs. The ecological characterization or field survey can also serve as a basis for designing monitoring studies.

Study Design Criteria

When designing a study there are many variables and methods to consider. Several related aspects of study design include selection of parameters, statistical design, establishment of control areas, logistic considerations, cost and spatial considerations. If a monitoring program is planned, parameters can include estimates of species distribution and abundance, community structure analyses including diversity indices, physiological conditions such as growth rate and rate of productivity or processes such as primary productivity and benthic respiration (Hirsch, 1980).

Selecting parameters to be measured is often a difficult task. A priority in selecting parameters is choosing sensitive indicators for the anticipated environmental stress. For example, when using the predictive equations previously presented, those variables that are most critical for obtaining accurate estimates should be measured. Species lists provide a means for qualitative comparisons of biota prior to and following development. Diversity and other indices are not always adequate tools for distinguishing the effects of pollution from natural variation (Boesch, 1980). They can become more useful when used in combination

TABLE 4-24

PUBLIC AND PRIVATE SOURCES OF INFORMATION

Boating Industry Association
Gulf Coast Research Laboratory
National Data Buoy Office
National Marina Association
National Marine Manufacturers Association
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Individual State Sea Grant Programs and other universities and institutions
National Ocean Survey
National Weather Service
National Oceanography Command
State Geological Surveys
U.S. Army Corps of Engineers
U.S. Bureau of Census
U.S. Bureau of Land Management
U.S. Coast Guard
U.S. Department of Commerce, Coast and Geodetic Survey
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey
U.S. Naval Oceanographic Research and Development Activity

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with more comprehensive investigations of population and community dynamics. Species that have relatively long life spans and as adults have a low natural mortality may provide valuable historical information through age and growth rate analysis. Another quantitative measure is primary production (defined as the amount of plant biomass that accumulates in a given time interval). Methods for estimating net primary production (NPP) and biomass graphs are available in USFWS handbooks and field guides that evaluate NPP of wetlands, for example (Kibby et al., 1980).

The primary consideration in the selection of parameters is to choose the proper indicator organism(s) or parameters. Parameters directly linked with the activity in question, such as levels of fecal coliform bacteria in shellfish areas near marinas, can assist in establishing baseline data that can separate natural variability from changes due to the activity under study. A further consideration in parameter selection involves identifying organisms or populations that characteristically lend themselves to statistical sampling (i.e., benthos may be more useful than plankton). Predictive impact assessments can be improved by program results from studies designed with suitable hypotheses and consideration given to environmental variability, the need for replication, adequate sample size, and so forth. Laboratory studies, which may be more costly, may aid in the selection of field variables by allowing for the controlled testing of one parameter against a subject species or a phenomenon. For example, the effect of dissolved oxygen on pink shrimp maturation could be evaluated in the laboratory. However, laboratory studies can only indicate a capability, such as a behavioral capability exhibited by a test oyster species in response to a siltation overburden. Field responses by the same species may be different because of parameter interactions and a less controlled field environment.

In parameter selection considerable attention is given to cost, logistics, availability of reliable sampling and analytical procedures. A fundamental problem is that the costs of monitoring may be prohibitively high, thereby reducing the number of sampling observations that can be completed within a given budget, which in turn reduces the reliability of the data. Because of this, the parameters most critical to the anticipated issues should be selected for evaluation.

Baseline Studies and Monitoring Programs

Baseline studies can be conducted prior to proposed development activities. They are generally used as a reference for comparison with monitoring studies during the proposed activity to determine if the environment is subsequently changed. In actual practice many baseline and monitoring studies mesh to represent a continuum, thereby increasing the validity of the initial baseline. However, both baseline and monitoring studies are not always justifiable. In this case monitoring can develop trend information without an initial baseline study of the particular area of concern.

The duration and extent of baseline and subsequent monitoring plans should reflect the variability expected in the data. The time frame and spatial limitations are site specific. More time is required if the expected variability is high in order to obtain a better overview of the system. Detecting low level chronic impacts requires more observation than detecting catastrophic changes.

Baseline and subsequent monitoring data can be particularly valuable in the case of marinas because of the current lack of specific quantitative data. These studies would provide necessary input in the decision-making process in order to avoid or minimize environmental damage in advance. The transfer of findings gained from marina impact studies in one ecosystem to other similar systems facilitates meaningful management decisions concerning potential impacts.

4.5.2 Specific Concerns

The following sections present specific methods that are currently available for use in assessing impacts related to coastal marina development and operation. The techniques presented are not a recommendation but a representation of the types of methods in use. Handbooks and standards for assessing the loading and fate of selected pollutants and performing biological analyses and sampling are available from USEPA and USGS (U.S. Geological Survey), as well as from other federal agencies and state natural resource departments (USEPA, 1973a, 1980b, 1982; Greeson, 1977; and others).

Dredging and Spoil Disposal

The effects of dredging on the coastal environment can be expressed in terms of siltation, disposal banks, dredge channels, shoaling, changes in circulation patterns, and surface (runoff) and groundwater contamination from upland spoil disposal. The U.S. Army Corps of Engineers developed the "Dredged Material Research Program" in order to expand the state of knowledge and provide definitive information on what constitutes an adverse impact caused by the nature of the dredged material or the method of spoil disposal. The program, conducted at the Corps of Engineers Waterways Experiment Station at Vicksburg, Mississippi, attempts to quantify effects or determine alternatives for solutions to problems associated with dredge and fill activities. Table 4-25 outlines the program which is divided into four project areas, environmental impacts and criteria development, disposal operations, productive uses, and habitat development. Habitat development field studies include research being performed in North Carolina, Georgia and Florida concerning island, marsh and seagrass development (Smith, 1980).

A variety of methods exist for determining and predicting physical impacts. Aerial surveys can help identify grassbed areas and indicate existing damage such as that from boat propellers. Aerial photography can be used to examine physical factors including circulation and sediment transport. Physical factors may be assessed using bathymetric data,

TABLE 4-25

TECHNICAL STRUCTURE OF THE U.S. ARMY CORPS OF ENGINEERS' DREDGED MATERIAL RESEARCH PROGRAM[a]

Project/Task		Objective
Environmental Impacts and Criteria Development Project		
1A	Aquatic Disposal Field Investigations	Determine the magnitude and extent of effects of disposal sites on organisms and the quality of surrounding water, and the rate, diversity, and extent such sites are recolonized by benthic flora and fauna.
1B	Movements of Dredged Material	Develop techniques for determining the spatial and temporal distribution of dredged material discharged into various hydrologic regimes.
1C	Effects of Dredging and Disposal on Water Quality	Determine on a regional basis the short- and long-term effects on water quality due to dredging and discharging bottom sediment containing pollutants.
1D	Effects of Dredging and Disposal on Aquatic Organisms	Determine on a regional basis the direct and indirect effects on aquatic organisms due to dredging and disposal operations.
1E	Pollution Status of Dredged Material	Develop techniques for determining the pollutional properties of various dredged material types on a regional basis.
2D	Confined Disposal Area Effluent and Leachate Control	To characterize the effluent and leachate from confined disposal facilities, determine the magnitude and extent of contamination of surrounding areas, and evaluate methods of control.
Habitat Development Project		
2A	Effects of Marsh and Terrestrial Disposal	Identification, evaluation, and monitoring of specific short-term and more general long-term effects of confined and unconfined disposal of dredged material on uplands, marsh, and wetland habitats.
4A	Marsh Development	Development, testing, and evaluation of the environmental, economic, and engineering feasibility of using dredged material as a substrate for marsh development.
4B	Terrestrial Habitat Development	Development and application of habitat management methodologies to upland disposal areas for purposes of planned habitat creation, reclamation, and mitigation.
4E	Aquatic Habitat Development	Evaluation and testing of the environmental, economic, and engineering feasibility of using dredged material as a substrate for aquatic habitat development.
4F	Island Habitat Development	Investigation, evaluation, and testing of methodologies for habitat creation and management on dredged material islands.
Disposal Operations Project		
2C	Containment Area Operations	Development of new or improved methods for the operation and management of confined disposal areas and associated facilities.
5A	Dredged Material Densification	Development and testing of promising techniques for dewatering or densifying dredged material using mechanical, biological, and/or chemical techniques prior to, during, and after placement in containment areas.
5C	Disposal Area Reuse	Investigation of dredged material improvement and rehandling procedures aimed at permitting the removal of material from containment areas for landfill or other uses elsewhere.
6B	Treatment of Contaminated Dredged Material	Evaluation of physical, chemical, and/or biological methods for the removal and recycling of dredged material constituents.
6C	Turbidity Prediction and Control	Investigation of the problem of turbidity and development of a predictive capability as well as physical and chemical control methods for employment in both dredging and disposal operations.
Productive Uses Project		
3B	Upland Disposal Concepts Development	Evaluation of new disposal possibilities such as using abandoned pits and mines and investigation of systems involving long-distance transport to large inland disposal facilities.
4C	Land Improvement Concepts	Evaluation of the use of dredged material for the development, enhancement, or restoration of land for agriculture and other uses.
4D	Products Development	Investigation of technical and economic aspects of the manufacture of marketable products.
5D	Disposal Area Land-Use Concepts	Assessment of the technical and economic aspects of the development of disposal areas as landfill sites and the development of recreation-oriented and other public or private land-use concepts.

NOTE: This technical structure reflects the second major program reevaluation made after the second full year of research accomplishment and is effective as of August 1975.

[a] Excerpted from Smith, 1980.

tide data, wind data, streamflow, current velocities, current directions and turbidity patterns. These factors will help identify areas of shoaling and basic circulation patterns. Wave ray tracing is also a method to determine the effect of any proposed dredging on the distribution of wave energy along the coastline before dredging is carried out (Kinsman et al., 1979). Ground-truth analyses may be needed for aerial photograph verification. Closer observations might include diver observation and selected measurement of sediment depths, as well as grain size sediment analyses, particularly in suspected siltation areas related to dredging. Dye and drogue studies could also be conducted to determine dilution capacity and circulation patterns, which would help predict the fate of turbidity plumes and the ecological areas likely to be affected. Dye studies would also provide a baseline to allow determination of possible future changes in circulation. The U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency developed the elutriate test as a laboratory procedure designed to simulate the disposal of dredged sediments with respect to the release of chemical contaminants from the sediments during dredging and subsequent disposal operations. In these tests a sample of the sediment to be dredged is dispersed in the water of the proposed spoil disposal site in a ratio of 1:4. After a period of time, the sediment is filtered and the water is analyzed for the constituent of concern. The elutriate tests assist in the development of acceptable dredging and disposal techniques and criteria. Bulk sediment analyses and bioassays may also be required. The parameters measured during the baseline should be monitored after dredging in an attempt to evaluate the effects of dredging. Not all subsequent changes, however, would necessarily be attributable to dredging or would necessarily be ecologically undesirable.

Upland disposal sites may be monitored for runoff. Confinement of runoff is recommended if the spoil contains hazardous or polluting constituents. Groundwater may also be monitored, particularly in old spoil confinement basins that may allow groundwater seepage. This would involve drilling observation wells in selected areas for water quality monitoring and sample collection. Odorous compounds in the air can also be monitored at disposal sites by gas chromatography/mass spectrometry. Detection threshold, intensity and character of odors in problem areas can be determined by experienced panelists using a dynamic, forced-choice-triangle olfactometer (Harrison et al., 1976).

Water Quality

Standard measurement methods are available for most water quality parameters. Some parameters associated with marina development surveys include dissolved oxygen, turbidity, total suspended solids, salinity, temperature, pesticides, nutrients (e.g., total inorganic nitrogen), bacteria (e.g., fecal coliforms), and various metals (e.g., copper, lead, mercury, zinc, nickel, arsenic, cadmium, chromium: Williamson et al., 1977). Examination of all of these parameters may not be necessary. Site-specific parameters related to local industries and other effluent sources should be considered.

Water pH (acidity), BOD (biochemical oxygen demand), COD (chemical oxygen demand), TOC (total organic carbon), total phosphorus, and oil and grease may need to be measured. Oil and grease measurement may be appropriate for marinas because of boat usage. BOD is related to DO, which may be an indicator of organic loading. Total phosphorus measurement may be appropriate in estuaries limited by phosphorus instead of nitrogen.

Some water quality parameters, such as pesticides and metals, also may be measured in sediments. Physical parameters such as grain size composition should be determined so that spoil sediment quality can be matched (Hirsch et al., 1978; Reimold et al., 1978) with disposal area sediments if a wetland or open-water disposal site (although not recommended) is to be used.

Water quality monitoring can be accomplished through multiparameter instrumentation that directly measures pH, DO, temperature, conductivity, and other parameters within the water column so that *in-situ* depth profiles can be made. Monitors for *in-situ* groundwater measurements that can be lowered into observation wells are also commercially available as well as various meters which individually measure one or more water quality parameters.

Water turbidity may be analyzed in the laboratory with a turbidity meter. Field measurements of sunlight transmittance (related to turbidity) can be made by using a Secchi Disk, photometer, or related instruments. Photometers measure the percentage of light transmittance at a given water depth. The light zone in which photosynthesis occurs is a function of the suspended particulates in the water.

Ecology

Biological specimens are often qualitatively or quantitatively collected and taxonomically identified to establish an ecological baseline for a given site. Vegetation surveys of wetland areas are useful to determine existing species, especially any rare and endangered species. Seagrass stands can also be assessed in terms of species composition, grassbed areal distribution, and biomass (dry weight of living material). Seagrass studies would involve diver observation, grass plug sampling, and biomass laboratory analysis. Shellfish standing crop, strata types and species can be important baseline considerations for marina development.

Animal populations can be evaluated through observation (birds), entrapment (small mammals), tagging (mark and recapture for fish and wildlife), and sampling (benthic communities). Benthic macroinvertebrates can be grab sampled with dredges (for example, Ponar), enumerated, and taxonomically identified. Species diversities such as the Coefficient of Similarity Index are also often calculated to determine the "health" of a community or the effects of a perturbation such as dredging. In general, a more diverse benthic community is considered "healthier" than one with a few successful species; a greater percentage of similarity between affected and control stations suggests a limited pollution effect. Fish species can be sampled with seines, traps and trawls. However, fishes, as opposed to benthic macroinvertebrates, are less useful indicators of pollution since they are motile and can often escape or avoid pollution. Pollution can, however, become a problem for fish if migration routes are blocked or an entire embayment is affected. Plankton may also be sampled by collecting water samples at various depths of the euphotic zone and compositing them into one sample that is then subsampled by volume. Fecal coliforms can be collected just below the surface of the water and then cultured and counted (most probable number) in the laboratory. Field sampling methodologies may be available from the literature of the USEPA, the U.S. Geological Survey (USGS), and the Department of Natural Resources (DNR) of most states.

Controlled laboratory studies may also be conducted to determine effects of specific perturbations to certain species. Data can complement and refine field results. Algal and sediment bioassays are methods for evaluating the suitability of a particular dredged material for disposal. Such bioassay tests require controlled environments, test subject acclimation periods, replicate testing, and several concentrations of the parameter being tested (e.g., turbidity). Examples of laboratory studies regarding the effect of suspended solids on estuarine plankton, for example, are presented in Sherk et al. (1976).

Shoreline and Protective Structures

Relevant to shoreline and protective structures, impact assessment study areas include circulation (longshore drift, tides, currents, winds, prevailing patterns), sedimentation and erosion, water quality (turbidity, dissolved oxygen, wood preservative leaching), structure design and engineering, and bioassay evaluations.

Circulation studies may be accomplished through predictive modeling studies and field observations such as dye studies for describing the distribution of currents in a specific area. Published literature may be used to predict typical areas of sand deposition and erosion based on physical phenomena in response to structure placement. Predictive onsite studies also may be necessary to account for unique local conditions such as current eddies and weather events. Such studies may help avoid subsequent near-structure sand accumulation, downcoast erosion effects, and costly maintenance dredging (which can have adverse ecological effects). Biological field tests, such as fish behavior studies relative to fish migration (e.g., through a permeable breakwater), would also be useful, especially in areas of anadromous fishes (e.g., striped bass).

Bioassay experiments may be valuable to delineate the lethal concentrations of chemical wood preservatives, such as copper derivatives and creosote, for target and non-target subject species. Data regarding leaching rates and toxicities do not appear to be adequate at present.

Sanitary Wastes and Runoff

Flushing rates and circulation characteristics of an estuary, the levels of existing organic and chemical pollutants, and a general assessment of biological community health are important areas where information is needed to assess the potential impacts of sewage pollution and runoff. Appropriate field sampling studies take into account variations in environmental factors such as tidal stage, season of the year, vertical distribution, or substrate type.

Assessment techniques for data gathered in field surveys are readily available from many sources, one of the most complete being EPA's Water Quality Assessment: A Screening Procedure for Toxic and Chemical Pollutants (USEPA, 1982). This resource provides needed information on the environmental chemistry of toxic chemicals, estimation of organic pollutant loading, impacts of point and non-point sources of conventional and toxic pollutants, flushing time calculations and pollutant transport in estuaries, all of which may be useful in ascertaining or predicting the environmental impact of sewage pollution and runoff from marinas.

In-situ monitoring may be carried out using standard data gathering techniques (meters or other recording devices) or using oysters, barnacles or other sedentary organisms as live monitors. Barber and Trefry (1981) found that a 1 ppb increase in dissolved copper levels in waters downstream from a boat harbor brought about a 36 ppm increase in the copper found in ivory barnacle (Balanus ebureus) tissues. This copper concentration factor of 36,000 illustrates the utility of biological indicators. Barber and Tretry (1981) also reported that barnacles were suitable for monitoring zinc concentrations.

Oysters were used as monitors of organic pollution by Scott and Lawrence (1982). The use of a standardized, easily measured index of oyster condition (Lawrence and Scott, 1982) has been proposed in which the condition index equals the dry weight of the oyster meat (in grams) multiplied by 100 and divided by the internal cavity volume (in cubic centimeters). Oysters have also been shown to be sensitive to other potential marina effluents such as chlorine (Scott and Middough, 1978; Scott and Vernberg, 1979). Ridge back prawns (Sicyonia ingentis) and Dover sole (Microstomus pacificus) were utilized by Rau et al. (1981) as indicators of sewage uptake while blue crabs (Pearson and Olla, 1980) and marine mussels (Burno and Smith, 1981) were used as indicators of pollution from petroleum. Except for the case of oysters used in monitoring organic pollution, the use of live monitors generally requires the use of expensive, state-of-the-art chemical analysis equipment such as liquid or gas chromatography, and atomic absorption or mass spectrophotometers.

Modeling can be used as a predictive tool to possibly avoid the costs of post-hoc testing to ascertain if anticipated problems have occurred. Kelch and Lee et al. (1978), for example, developed a predictive model for coliform in estuarine environments. The goal is to determine the contribution of recreational watercraft to fecal coliform levels. The model makes use of environmental parameters (temperature, precipitation, river flow, and tide information), bacteriological data, antibiotic resistance factors for the bacteria isolated, and recreational use data.

Boat Operation and Maintenance

General methods of assessing physical impacts of boat operation have been discussed in previous sections. Aerial photography, for example, can be used for assessing dredging impacts and characterizing an area, as well as a method for measuring boat propeller damage to seagrass beds. Assessment of impact from boat collision with sea turtles or manatees is complicated by the lack of information on total populations. Population studies on these animals are being conducted by several public and private organizations, notably the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.

Impacts on other wildlife, such as the effect of marina and boat noise on local bird populations, can be measured by observation and counts. Assessment of water bird populations is relatively easy compared to other wildlife because the birds are highly visible, are active during the day, and often nest in colonies that are well-delineated spatially. All bird census techniques require accurate counts conducted either from the air with ground truthing or on the ground only. Specific methods vary with the species and the habitats where they occur. These methods are well described by Parnell and Soots (1979). Counts are made of the number of nesting adults, the number of nests, the number of eggs, or a combination of the three. These enumerations are then compared on a year-to-year basis to monitor the condition of the colony.

Although the water bird population assessment is relatively uncomplicated, it is often difficult to attribute population changes to a specific cause. Human disturbance may disrupt a nesting colony, particularly if it occurs when the nests are being established, and result in a rapid nesting population decrease. On the other hand, a decreasing population trend over several years may be related to humans, disease, climate, or other factors.

The effects of pollutants from boat operation and maintenance, including hydrocarbons and lead, are generally assessed through the use of standard bioassay techniques (methods are delineated in Peltier, 1978) conducted under laboratory conditions. Test organisms are subjected to varying concentrations of pollutants over varying time periods to determine when and at what concentration mortalities or sub-lethal effects (such as cessation of growth or disruption of normal behavior) occur.

4.6 Summary

The environmental impacts associated with marina development and operation may be temporary or long-term. The potential for undesirable environmental impacts is a function of many variables, including marina location, design, services offered, number and type of boats served, marina management and operational performance. As a result, the potential for or the degree of undesirable environmental changes is not the same for all marinas. Marinas that are adjacent to environmental sensitive areas or areas prone to shoaling or poor flushing may be more susceptible to water quality problems and could be more expensive to develop and maintain.

Adverse impacts from marina construction and operation may result from:

- Dredging and spoil disposal
- Placement and design of shoreline and protective structures
- Wastewater discharge and runoff
- Boat operation and maintenance.

Adverse impacts from dredge and fill operations may result from seagrass and benthic habitat loss, wetland alteration, destruction of shellfish beds, increased turbidity or siltation, reduced dissolved oxygen or resuspension of plant nutrients or toxic pollutants. Benefits may result from the addition of nutrients in nutrient-limited areas or from improved water circulation or flushing in stagnant areas.

Shoreline and protective structures affect the physical, chemical and biological components of the environment. Adverse effects may result from alterations in water circulation, deposition/erosion characteristics, blockage of migration routes or sunlight, elimination of shallow-water habitat or addition of toxic chemical preservatives. These structures also may provide suitable habitats for colonization which may compensate for natural habitat altered or lost during construction. Certain structures may also attract sport fishes into the area.

Runoff from marinas and sewage discharge from boats in shellfishing areas may affect the utilization of the shellfish for food or the productivity of the shellfish. Because shellfish are filter-feeders, they can concentrate pathogens derived from sanitary wastes or the chemical pollutants from boat operation and maintenance that may enter the water directly or through stormwater runoff. Boat operation also may result in physical impacts to shorelines and to sensitive biota including intertidal oyster reefs, seagrasses, mangroves, waterfowl, manatees and sea turtles.

Techniques that can be used to predict flushing time, sediment deposition and shoaling rates, sedimentation from dredging and structure emplacement and pollutant concentrations in the absence of site-specific data are provided for addressing these environmental impacts.

Predictive techniques that have been used to estimate the area of impact resulting from sanitary wastes discharged from boats in a marina are discussed. Complications that can arise in evaluating impacts using these methods include:

- Variable boating population
- Mobility of the boats
- Intermittent pollution contribution
- Varying levels of treatment
- Treatment devices with varying ranges of efficiency
- The epidemiological background of a transitory population contributing fresh fecal pollution.

Techniques that can be used to evaluate the potential impact to aquatic and wetland habitats from burial by sediments derived from dredging operations are detailed.

Results from these methods can be readily used to provide reasonable approximations for evaluating potential problem areas. These results may be used to alleviate concerns for potential adverse impacts or to serve as an indicator that a more precise determination based on data measured at the marina site may be required before making a final decision on site or design feasibility.

5.0 ENVIRONMENTAL SOLUTIONS: IMPACT MITIGATION

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5.0 ENVIRONMENTAL SOLUTIONS: IMPACT MITIGATION

5.1 Overview

The ultimate environmental performance of a properly sited coastal marina depends on the marina design, construction and operation. Most coastal construction projects, including coastal marinas, will impact the coastal environment in a variety of ways. This chapter is designed to provide the Handbook user with alternative measures or "environmental solutions" that can be used to solve potential environmental impact problems. The chapter provides guidance for the resolution of those potential impact problems first identified using the Coastal Marina Screening checklist in Chapter 3.0 and then evaluated using the techniques discussed in Chapter 4.0.

Section 5.2 begins with an introduction to the concept of impact mitigation as used in the context of this Handbook. The importance of marina location for avoiding or minimizing potential impacts is stressed in Section 5.3. Section 5.4 presented environmental impact mitigative measures that can be used during coastal marina design and construction. Following the format of Chapter 4.0, this discussion is divided into water quality, ecological and other categories, acknowledging the considerable overlap in application that may be involved. Marina operation and maintenance, critical factors for the success of an environmentally sound design, are discussed in Section 5.5. Appendix B presents specific cost calculation information for the slipside wastewater collection and disposal systems discussed in Section 5.4.1. Appendix C provides a detailed discussion of shellfish purification technology, an approach that in the future may allow recovery of shellfish resources lost due to water quality problems.

5.2 Environmental Impact Solutions Through Mitigation

5.2.1 Definition of Mitigation

The term "mitigation" was first used in connection with wildlife in the Fish and Wildlife Coordination Act (Rappoport, 1979). However, mitigation and the philosophy behind it have never been consistently or clearly defined by all agencies connected with its use.

According to the dictionary definition, mitigation is the "abatement or diminution of something painful, harsh, severe, afflictive...". This definition implies that mitigation involves corrective action (compensation, restoration, replacement, etc.) only after impact has occurred.

The above definition is valid; however, it only goes part of the way in dealing with impact-related issues. What is missing is the concept of prevention, which would avert or limit impact effects prior to occurrence. "Mitigation" has thus evolved to include avoiding and minimizing project impacts on natural resources during project planning and implementation, as well as corrective action following impact. This broader definition is stated in the National Environmental Policy Act (NEPA; Section 1508) and includes:

- Avoiding the impact altogether by not taking a certain action or parts of an action
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments.

In short, mitigation means lessening losses through the use of preventative measures and offsetting losses through the use of other structural and non-structural measures (Krulitz, 1979). In this chapter, the term "mitigation" will be used in the general sense as defined in the NEPA Regulations.

5.2.2. Mitigative Concepts

The primary mitigative (or management) approach is one of preventative conservation, designed to protect an ever shrinking base of certain habitats and avoid costly man-assisted restoration efforts. It is founded on preventing adverse, predictable and irreversible trends or changes in aquatic and terrestrial natural systems. The objective is to maintain as much of the existing ecosystems as possible, even if the structure, function and relative importance of these ecosystems are not fully known (Jahn, 1979). The mitigative approach to meet this objective is to pursue feasible and prudent alternatives to a proposed project and/or examine all feasible measures to reduce or counteract adverse impacts associated with that project. Where remedial action is indicated, it should be of sufficient size and properly designed so as to offset the adverse impacts of a proposed project.

Steps in the mitigative approach (evaluation method) should include (compiled from Hall and Vogt, 1979; Rappoport, 1979; Wood and Swift, 1979):

- Early planning, which is often the key to minimizing or avoiding conflicts over development. This includes the early and coordinated involvement of all interests (national, regional and local; public and private) in plan formulation and implementation to establish a team effort
- Development of a soundly conceived plan to satisfy legitimate human needs and/or desires. This plan must

be verified as technically sound and objective; data generated must be documented, replicable and compatible in detail with other elements of the planning process; the plan must be compatible with project design and scheduling, including timing of plan presentation; and the validity of the plan must be accepted by those interests involved

- The mitigative method(s) developed must be implementable within the planning framework. Perserverance and follow-through is required by the team to ensure plan implementation and operation.

5.2.3 Extent of Mitigation

The extent of mitigation needed for a given project may be based on consideration of the following factors (modified from Coenen and Cartright, 1979):

- The extent of proposed dredge and/or fill activity in intertidal and marsh areas
- The biological productivity and important resource values of the site. (This should be based on a functional and qualitative assessment of existing communities, habitats and resource characteristics)
- The adverse impacts and the extent to which they can be minimized through modification of project design or reduction in project scope
- The identification of any remaining adverse impacts to be mitigated by restoration, compensation or other measures.

5.2.4 Marina-Related Mitigative Measures

The three greatest adverse impacts in the estuarine ecosystem are the loss of surface area (by filling), the loss of shallow intertidal benthic habitat (by either filling or dredging) and the degradation of water quality. As a minimum, mitigation efforts should be designed to maintain, to compensate for or to restore these three parameters (LaRoe, 1979).

5.3 Marina Location

There are institutional measures in addition to the desirable site characteristics discussed in Chapter 3.0 that can help ensure that marinas are developed in an environmentally sound manner. Comprehensive regional planning may be considered as a first mitigative measure for marina siting, instead of the widely used single site approach that may not consider more suitable alternative locations. Following determination of present and projected marina demand, alternative sites may be evaluated with the goal of choosing the most suitable site or sites. Those that meet the requirements of marina operation and, at the same time, require the least loss of environmental values. This type of planning may involve designation of "vital", "critical" or "sensitive" areas of environmental concern.

One effective approach may be to give priority to the expansion of existing facilities, if environmentally sound, over new facilities (Cato, 1983) or to encourage use of previously disturbed areas for new marina sites. For example, numerous navigation channels have already been cut along the coast. Siting marinas on existing channels could reduce or avoid the need for additional dredging. Many areas also have extensive systems of dredged canals with single family homes on filled land. It may be possible to site marinas in these areas, rather than dredging and filling in undisturbed areas (Maloney et al., 1980a). The high cost of residential waterfront property, zoning ordinances and aesthetics are all potential obstacles to this management alternative.

Encouraging centrally located marina facilities rather than providing navigational access to individual lots may be effective in reducing impacts in new residential developments (Maloney et al., 1980a). Centralized facilities reduce the disruptive influence on coastal wetlands by concentrating watercraft in one area and the management of upland support activities can be accomplished more effectively.

5.4 Marina Design and Construction

Proper site planning can avoid or minimize many of the impacts that can result from marina development. Selecting the marina location that will complement the marina concept and designing the marina to permit maximum use of the natural attributes of the site can facilitate the entire development process from permit application through completion of construction.

Design Considerations and Procedures

The successful design of marinas and structures requires an awareness of the environment, its characteristics, and the variety of impacts that can potentially occur. To assure the function and longevity of the marina and marine structures, the designer also must choose appropriate construction materials and understand their limitations. Finally, the marina designer must carefully evaluate the costs of materials and structures with respect to longevity and safety.

Marina design can be considered a two-phase procedure. The first phase is the preliminary design and the second phase is the detailed design. The preliminary design phase amplifies the conceptual plan developed in the planning effort. During the preliminary design, hydrographic and topographic survey work is conducted, meteorological data is verified, and supplemental measurements of the tidal zone's dynamic characteristics are collected as required to support and confirm hypotheses identified in the feasibility study. Additionally, a water quality sampling program can be considered, along with a flora and fauna assessment. All information collected in the preliminary design should be evaluated to serve as the data base upon which the detailed design is based.

The detailed final design, resulting in construction plans and specifications, can be broken into four components. The first is onshore site design that includes consideration for vehicular and pedestrian access, launching facilities, buildings, recreation areas and landscaping. The second component is the watercourse design. Features such as final channel alignment, dredging requirements, final basin configuration and dimensions are included in the detailed watercourse design. The third design component includes consideration of dockage structures such as piers, piles, and dolphins and wave attenuation and erosion/recession control structures such as breakwaters, jetties, bulkheads, groins and revetments. The last component of the final design involves consideration of ancillary marina systems including sanitary waste facilities, utilities (electric, phone, water, television cable), solid waste disposal, storm water management, fuel storage and delivery facilities, and fire protection.

Design Criteria

The basis for the preliminary design and the subsequent final design is a comprehensive data base. As a minimum the following information is required (Chamberlain, 1983) to provide the foundation for optimal final design:

- Plats, maps, and charts for the potential site and immediate surrounding areas can include USGS quadrangle maps, state or county charts and maps, aerial photographs and surveyor's plot plans

- Bathymetric surveys should be conducted on the proposed marina basin area as well as those areas that will be utilized as channels, whether existing or proposed. Water depths can affect nearly the entire marina layout and design

- Soil borings provide information on the characteristics of the site's underlying soils. This information forms the basis for the design of pilings, bulkheads, jetties, breakwaters, and building foundations and, therefore, must be accurate and up-to-date

- A working knowledge of the magnitude of water level fluctuations is required to design the marine structures. In addition to tidal range data, data on extreme high and low water levels also should be considered

- Waves caused by wind or by passing vessels affect marina design. Theoretical wave height formulas are available for preliminary wave height determination. Field observations also should be conducted at the proposed marina site during high wind conditions and when boat traffic is heaviest

- The marina design should consider prevailing wind velocity and direction, and how wind characteristics change with time of day and time of year. In addition, the extreme wind velocity and direction data are useful. The wind characteristics can affect the design and orientation of wave suppression facilities within the marina

- Current velocity and direction data are generally available to the engineer, but may be presented in the form of average measurements. Field verification of data is prudent, particularly for extreme events such as flood conditions and spring and neap tides

- Discussions with persons who live on or near the site can provide very useful information. Of particular interest are items such as the existence of wood borers, problems with algae, mussels, barnacles, seaweed and bottom grasses, as well as historic weather, wave and current information. This information will assist in optimal design of facilities.

Construction Considerations and Procedures

The detailed final design results in plans and specifications that identify the physical characteristics of the marina and graphically show planned structures, their layout, dimensions, materials, profiles, construction details and other information required for cost estimating and construction of the marina. Because of the nature of marine construction, certain unavoidable short-term construction impacts can be planned for in advance. These short-term impacts can be minimized through careful planning, preconstruction preparations (pre-bid qualification requirements), and qualified construction inspection.

Project specifications can include special construction practices such as soil erosion, sedimentation and stormwater runoff control plans. Also, procedures for containment of silt and sediment during dredging and structure emplacement. Dedication of permanent upland dredged material disposal sites and disposal procedures may be necessary.

Successful completion of the project requires competent contractors experienced in the use of proper equipment and accepted construction practices. The developer can adopt prequalification procedures to evaluate prospective bidder qualifications and to determine the bidders that are best qualified to undertake the construction contract.

Construction inspection is an important aspect of successful development that may be overlooked. All construction should be supervised by a qualified inspector who has the authority to reject any materials, workmanship or construction practices that are not in accordance with project specifications. This also will help ensure that dredging is carried out only in the areas designated and to the proper depths required by construction specifications.

5.4.1 Water Quality Mitigative Measures

Flushing

Adequate flushing of a marina is necessary for maintaining the water quality of the marina basin and adjacent waterway. Natural circulation near the site should be maintained whenever possible. Poorly flushed marinas can become stagnant and permit the concentration of pollutants from the marina facility and boats. The settling and accumulation of organic material and fine sediments can result in decreased dissolved oxygen levels and shoaling within the marina basin.

Marina Basin Design

Open marinas located on existing channels will generally have the same flushing rate as the channel. Semi-enclosed marinas or marinas with dredged basins should be designed to maximize tidal exchange and mixing within the marina. Marina basin design features that promote flushing are:

- Basin depths that are not deeper than the open water or channels to which the basin is connected and never deeper than the marina access channel
- Basin and channel depths that gradually increase toward open water
- Two openings at opposite ends of the marina to establish flow-through currents
- Single entrances that are centered in rectangular basins rather than at one corner
- Basins with few vertical walls and gently rounded corners or circular or oval shaped
- Even bottom contours, gently sloping toward the entrance with no pockets or depressions.

Generally, a rectangluar basin is accepted as the best geometric shape for maximizing both the number of boat slips and basin circulation. The minor dimension of the rectangluar basin should be a multiple of 61 to 76 meters (200 to 250 feet). To maximize flushing and minimize waves, the basin should have as few vertical walls as possible, interior corners gently rounded with constantly changing radii and a bottom sloped toward the exit and main waterway (Chamberlain, 1983). The flushing potential of several marina basin configurations is illustrated in Figure 5-1.

Mechanical Devices

In areas where tidal exchange may not adequately flush the marina, mechanical means such as tide gates or one-way valves may be used to enhance flushing rate. However, the performance of these systems should be carefully evaluated before installation. Such systems have been used in Florida to flush canals in dead-end lagoon developments (Giannio and Wang, 1974).

For locked-harbor marinas dredged from uplands, flushing may be induced by creating a tidal prism with the basin. A recent marina/residential development in South Carolina has been designed with different diameter pipes at each end of the marina basin. The basin is flooded on the incoming tide and the water flows out smaller diameter pipes on the ebb tide.

Where possible, flushing should be accomplished through basin design without the assistance of mechanical devices. Mechanical devices may be costly and will require maintenance.

Entrance Channel Design

Entrance channel design and placement can alleviate potential water quality problems. Entrance channels designed with openings as wide as possible and with increasing depth away from the marina basin promote flushing (Boozer, 1979; Figure 5-2). Flushing also is enhanced when entrance channels are located in the direction of prevailing winds where possible because wind-generated currents can mix basin water and facilitate circulation between the basin and adjacent waterway. Shoaling may be significant in entrance channels located perpendicular to waterways with significant bed load transport. Increased shoaling could require extensive maintenance dredging of the channel or create a sill at the entrance to the marina basin. Shoaling at the marina entrance can lead to water quality problems by reducing flushing and water circulation within the basin.

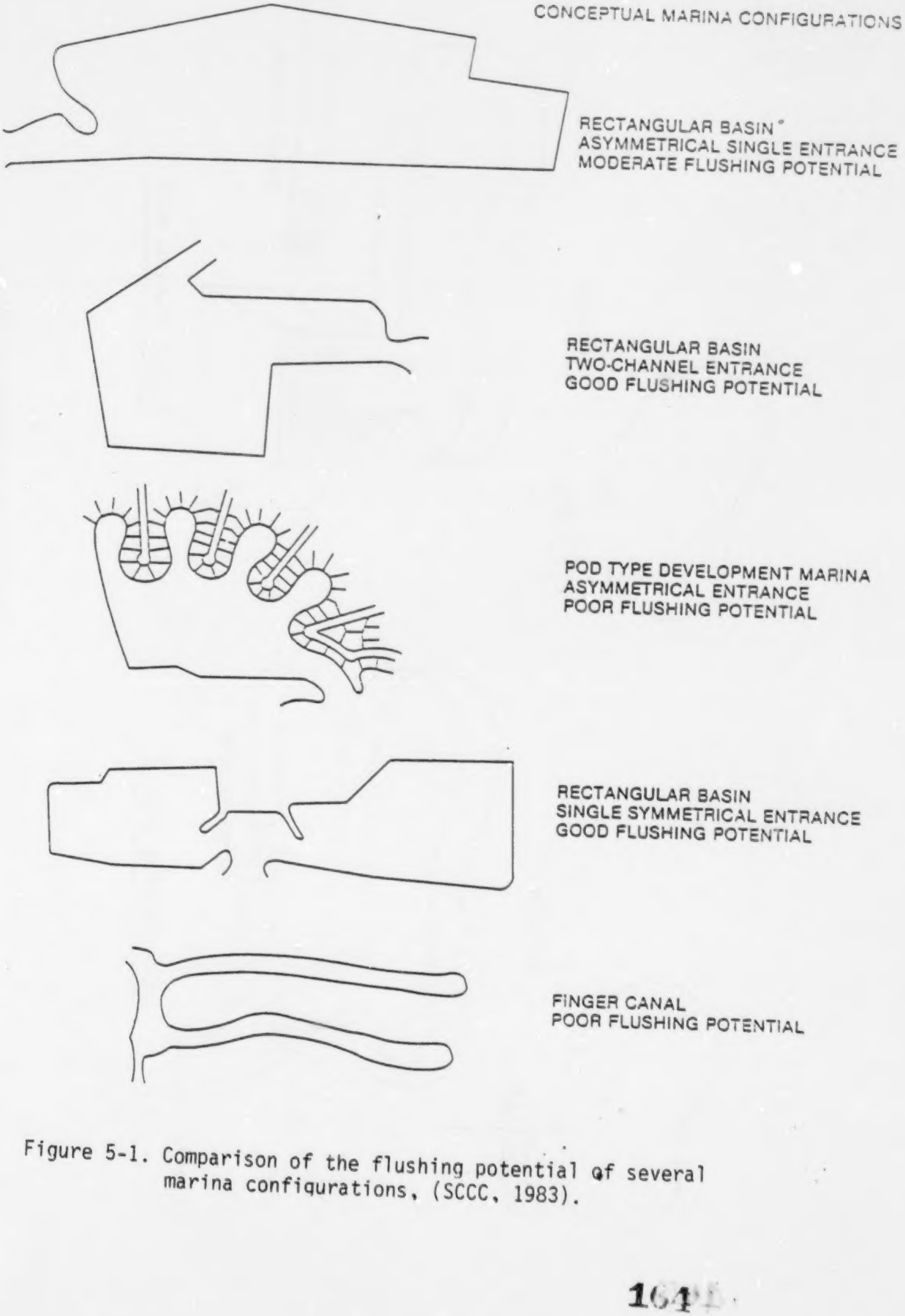
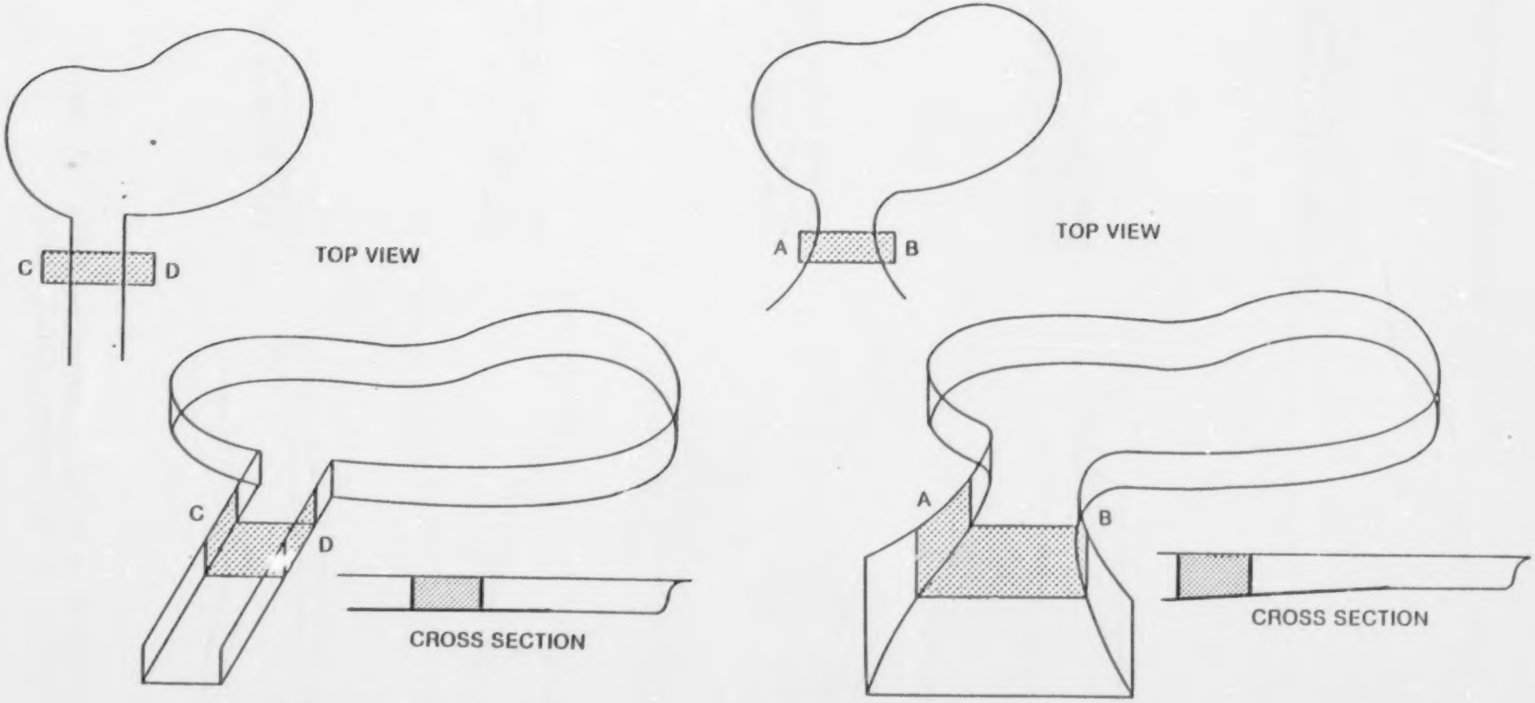

CONCEPTUAL MARINA CONFIGURATIONS
RECTANGULAR BASIN
ASYMMETRICAL SINGLE ENTRANCE
MODERATE FLUSHING POTENTIAL
RECTANGULAR BASIN
TWO-CHANNEL ENTRANCE
GOOD FLUSHING POTENTIAL
POD TYPE DEVELOPMENT MARINA
ASYMMETRICAL ENTRANCE
POOR FLUSHING POTENTIAL
RECTANGULAR BASIN
SINGLE SYMMETRICAL ENTRANCE
GOOD FLUSHING POTENTIAL
FINGER CANAL
POOR FLUSHING POTENTIAL

Figure 5-1. Comparison of the flushing potential of several marina configurations, (SCCC, 1983).


TOP VIEW
C
D
C
D
CROSS SECTION
TOP VIEW
A
B
A
B
CROSS SECTION

lower flushing rate

higher flushing rate

Figure 5-2. Marina cross sections showing differences in marina flushing, (Adapted from SCCC, 1983).

Dredging and Dredged Material Disposal

Dredging temporarily impacts water quality by increasing turbidity through the resuspension of the bottom sediments. These resuspended sediments can affect filter feeding organisms such as shellfish by reducing feeding rates, suffocate organisms by clogging gills, reduce primary productivity by reducing light penetration and bury benthic organisms through siltation. Resuspended bottom sediments can contain trace metals, toxic substances, nutrients and organic debris that can be released into the water column. Resulting water quality problems can include lowered dissolved oxygen concentrations and promotion of algal blooms.

The abatement of negative dredging effects initially involves assessing the need for dredging. Ideally, a marina should be sited in a well-flushed, circulated, protected, deep-water, natural harbor that does not require dredging for navigation or require spoil filling of submerged wetland areas. Realistically, such areas are not always available or economically feasible. However, minimizing the amount (area and volume) of material dredged and the frequency of dredging activities will reduce the environmental impact as well as the cost of maintaining the marina. Mitigative measures for impacts associated with dredging and dredged material disposal operations are compiled primarily from Boozer (1979), Chapman (1968), Clark (1979), Diener (1979), Lindall et al. (1979), NMFS (1983), BRMC (1983), Terrell and Shanks (1979) and VSWCB (1979).

Most marina developments require only small amounts of dredging and dredged material disposal (U.S. Department of Commerce, 1976). The most common marina-related dredging involves "spot" and maintenance dredging to remove sediment from problem areas in boat channels or near docks (Chmura and Ross, 1978). A recent alternative to dredging boat basins from shallow water areas has been the excavation of upland areas, connected to open waters by locks.

The marina developer's attention to environmentally sound marina development by avoiding or minimizing adverse impacts from design and construction can help assure success of the development, since marinas are dependent upon functional, healthy environmental systems for the public recreational service they provide. Generally, guidelines and mangement considerations are presented in Clark (1974), Chmura and Ross (1978), Boozer (1979), the Virginia State Water Control Board (VSWCB, 1979), National Marine Fisheries Service (NMFS, 1983), and others.

Water quality impacts may be avoided or minimized by (Maloney et al., 1980a; Ervin et al., 1980; Bednarz, 1983):

- Planning dredged channels that follow the course of natural channels
- Building slips for boats with deep drafts in naturally deep water

- Extending piers and docks as far as possible into naturally deep water
- Providing upland storage for smaller boats and using boat lifts to transport them to the water.

Dredging Method

When dredging is required, water quality impacts due to increased turbidity may be reduced by:

- Choice of dredging method
- Use of silt screens or similar containment methods.

The two types of dredges are mechanical and hydraulic. Mechanical dredges physically pick up and lift materials using various types of buckets or shovels. Hydraulic dredges utilize a centrifugal pump to move a slurry of water and material from the bottom through a system of pipes to the disposal site. An appropriate dredge should be selected based on considerations of site, operation, environmental impact, and cost. Common mechanical dredges include dipper, ladder and bucket; hydraulic dredges include pipeline and hopper. Descriptions of these designs are presented in Table 5-1 (excerpted: Clark, 1974).

Mechanical dredges have the advantage of not adding dilution water to the spoil and not requiring pipelines. They can remove hard materials and be operated on land or water. This type of dredge, however, is not economical for large volumes of material and is inefficient in deep water (VSWCB, 1979). Hydraulic dredges have the advantage of being productive for medium to soft bottom material, economical for large spoil quantities, and can rapidly remove benthic material from the site bottom. However, hydraulic dredges require large disposal sites and effluent filtration procedures (VSWCB, 1979). Hopper dredges apparently cause a relatively low amount of damage to the biota but are usually limited to construction and maintenance usage (Mulvihill et al., 1980).

Hydraulic dredges generally produce less turbidity at the dredge site since a suction pipe is used to remove dredged material. Negligible levels of turbidity are produced by a Japanese-developed pneumatic dredge. Due to the minimal agitation created by this dredge, it is valuable for dredging contaminated spoil (Golden et al., 1980). However, this type of dredge is inefficient and is not cost- effective (VSWCB, 1979). Disposal of hydraulic dredge spoil could, however, produce more turbid waters than mechanical dredge spoil since the former produces spoil in the form of a diluted slurry. If improperly dumped in open water without filtration, considerable turbidity could result.

TABLE 5-1

DESCRIPTIONS OF SEVERAL MECHANICAL DREDGES (DIPPER, LADDER, AND BUCKET) AND HYDRAULIC DREDGES (PIPELINE AND HOPPER)[a]

Dipper dredge	The dipper dredge is basically a power shovel mounted on a barge. The barge (which serves as the work platform for the shovel) uses three spuds (two spuds at the forward end and a single spud at the stern) to provide stability during dredging operations. The dipper dredge is capable of excavating from 3 to 10 cubic yards of hard material per cycle. It can remove blasted rock or loose boulders. The dredged material is discharged within the reach of the dipper boom. The digging boom limits the depth of excavation to not more than 60 feet.
Ladder dredge	The ladder dredge uses an endless chain of buckets for excavation. The dredge is mounted on a barge which is stabilized by side cables during the dredging operations. The ladder dredge is capable of excavating from 1 to 2 cubic yards of hard material per bucket. It can remove blasted rock or loose boulders. The excavated material is dumped from the buckets into chutes or onto belts and is discharged over the side of the barge. The design of the ladder limits the depth of excavation to not more than 100 feet.
Bucket dredge	The bucket dredge is basically a crane mounted on a barge. The bucket (clamshell, orange-peel, or dragline) can be changed to suit the job conditions and material to be removed. The barge (which serves as the work platform for the crane) uses either spuds or anchor lines to provide stability during dredging operation. The bucket dredge is capable of excavating moderately stiff material in confined areas. It is generally not used for large scale projects. The excavated material is dumped within the reach of the boom.
Pipeline dredge	The pipeline dredge is the most versatile and widely used dredge. It can handle large volumes of material in an economical fashion. Using a cutterhead the dredge can excavate material ranging from light silts to heavy rock. It can pump the dredged material through floating and shore discharge lines to remote disposal areas. Pipeline dredges range in sizes (as measured by the diameter of the pump discharge) from 6 inches to 36 inches. The depth of excavation is limited to 60 feet. The rate of dredging will decrease with 1) difficulty in digging, 2) increase in length of discharge pipe and 3) increase in lift to discharge elevation.
Hopper dredge	The hopper dredge is a self-propelled vessel designed to dredge material hydraulically, to load and retain dredge spoil in hoppers, and then to haul the spoil to a disposal area or dump. Loading is accomplished by sucking the bottom material through a dreg-head into the hoppers while making a cut through the dredging area. The quantity of volume pumped during a loading operation depends primarily upon the character of the material and the amount of pumping time involved as well as the hopper capacity and the pumping and propulsive capability of the dredge. The loaded dredge proceeds to the disposal area where the dredge spoil is discharged through gates in the bottom of the hoppers.

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[a] Excerpted: Clark, 1974).

Sediment Curtains

Silt screens may be used to confine suspended sediments in sensitive areas such as those near shellfish beds or grassbeds. Sediment curtains are effective in low current areas (1 to 1.5 knots) when properly maintained and monitored. Use of sediment curtains is illustrated in Figure 5-3.

Other Mitigative Measures

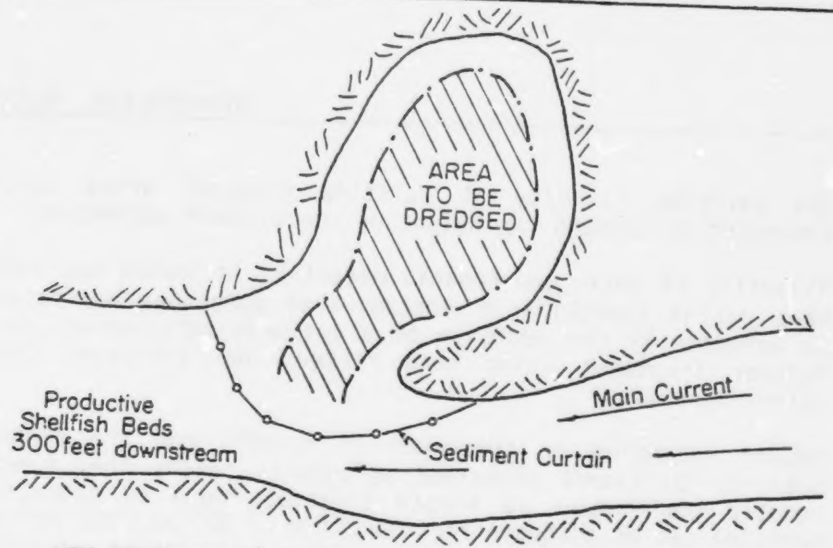
Other mitigative measures for dredging impacts include:

- Dredging during colder months when DO levels are higher (cold water has a greater capacity for DO than does warm water) would help mitigate dredging-related DO and BOD problems
- Dredging dead-end (Venetian) finger canals within a marina is undesirable. If canals are dredged, however, the banks of the canals can be sloped, as opposed to being at right angles with the bottom, to reduce stagnant, low DO pocket areas. Sloped banks can be stabilized with rip-rap to prevent erosion
- Water circulation can be ensured by using properly designed culverts, pilings and bridge spans, and by using discontinuous mounds for open water discharge.

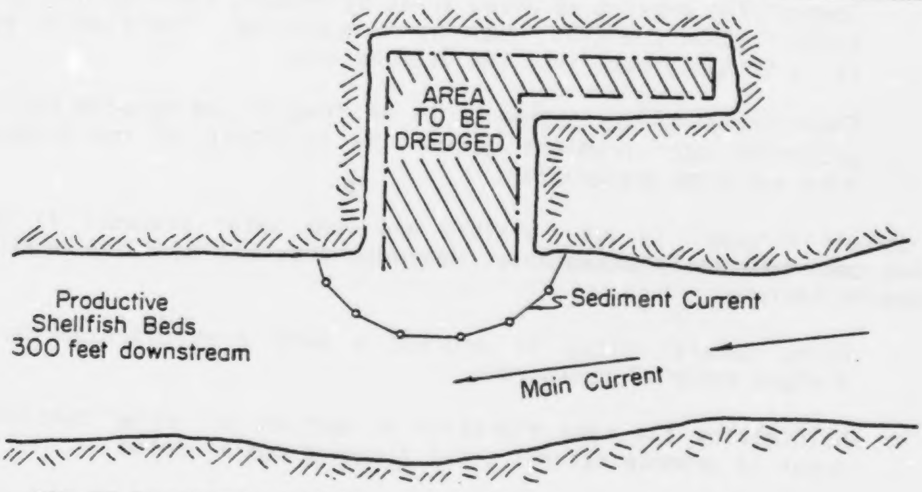
Dredged Material Disposal

Dredged material may be disposed of in open water, wetlands or upland sites. Open water disposal is seldom a viable option for marina projects and disposal on wetlands is unacceptable because of environmental reasons. Environmental solutions for potential disposal problems were compiled from NMFS (1983), Van Dolah et al. (1979), Wright (1978), Johnston (1981) and Reimold et al. (1978). Mitigative measures for dredged material disposal include:

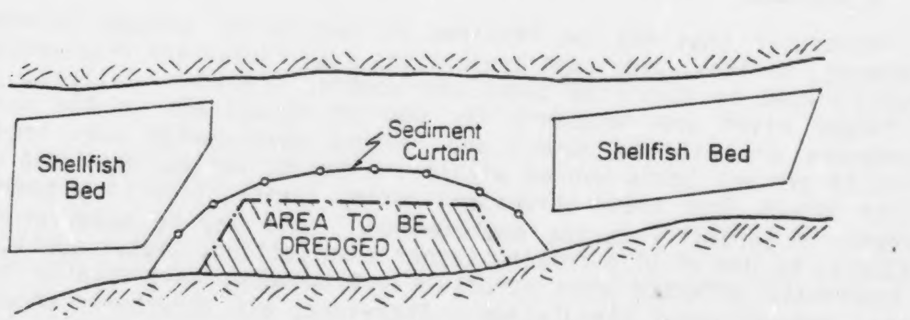
- Productive use of suitable dredged material for beach replenishment, construction, sanitary landfill and agricultural soil improvement
- Confining discharges to the smallest practicable deposition zone to protect adjacent substrates
- Use of currently permitted public disposal sites
- Dedicating permanent upland disposal sites as part of the marina specifications would help eliminate future problems related to disposal of maintenance dredging material. These permanent sites can be sites that have been previously used or represent an environmentally satisfactory alternative


AREA
TO BE
DREDGED
Productive
Shellfish Beds
300 feet downstream
Main Current
Sediment Curtain

USE OF SEDIMENT CURTAINS WHEN DREDGING IN A COVE


AREA
TO BE
DREDGED
Productive
Shellfish Beds
300 feet downstream
Sediment Current
Main Current

USE OF SEDIMENT CURTAINS WHEN DREDGING IN MAN-MADE CANALS


Shellfish
Bed
Sediment
Curtain
Shellfish Bed
AREA TO BE
DREDGED

USE OF SEDIMENT CURTAINS WHEN DREDGING ADJACENT TO SHELLFISH BEDS

Figure 5-3. Use of sediment curtains when dredging in different areas, (Virginia Marine Resources Commission, 1979)..

- The carrying capacity at existing disposal areas could be increased by raising the height of containment embankments
- Disposing of toxic and organic materials in impervious containment basins (settling of contaminated suspended particles may be enhanced by the addition of a cationic polyelectrolyte with further treatment using sand filters and activated charcoal before discharge)
- Upland retention or treatment of runoff from the discharged material to remove dissolved pollutants before they reach the aquatic environment (a simple treatment such as ozonation or aeration can be adequate for reduction of BOD and COD before the discharge of supernatant liquid from spoil areas enters into receiving waters)
- Controlling erosion at diked areas by shaping the dike and using stabilization measures, such as revegetation. Positioning outfalls to empty back into the dredged area
- Characterizing the sediments to be dredged and considering the potential odor problems during the selection of the disposal site and site preparation.

When upland disposal is not possible and open water disposal is considered environmentally acceptable, measures that can minimize problems or impacts include:

- Using several sites to provide a more even distribution of dredged material overburden
- Maintaining the same elevation as marshes and other contiguous areas to promote natural tidal flooding and flushing
- Situating spoil islands on the windward side of the dredged channel.

Structures

Structures that may be required at the marina include bulkheads, revetments, pilings, piers and breakwaters. Bulkheads and revetments are primarily used to stabilize banks and control erosion. Pilings, piers and finger piers are necessary for mooring watercraft in the marina. Breakwaters are used to absorb and reflect wave energy away from the marina to protect boats moored within the marina basin. A direct water quality impact from these structures during construction is a temporary increase in turbidity during emplacement. This may be alleviated, if necessary, by use of pile-driving rather than jetting. Water quality can be indirectly affected when structure emplacement, particularly breakwaters, reduces water circulation. Therefore, all structures should be designed and placed so as not to restrict water circulation or mixing within the marina basin or increase shoaling. Environmental solutions to potential problems related to protective and shoreline structures have been addressed by Bara et al. (1977), Boozer (1979), Chmura and Ross (1978), Mulvihill et al. (1980), and NMFS (1983).

Bulkheads and Revetments

Revetments are preferable to vertical bulkheading for controlling erosion because bulkheads provide less surface area than revetments, for colonization by organisms. Vertical bulkheads also can create reflection waves that can increase turbidity within the marina basin and can cause scouring at the base of the bulkhead. Placing these structures as far upland as possible not only avoids alterations to shallow intertidal and wetland areas, but also provides a vegetated buffer to filter stormwater runoff between upland facilities and the waterway. Where vertical bulkheads are necessary, they should contain weep holes, covered with a filter cloth to curtain sediments and to permit groundwater flow into the marina. Problems with floating debris accumulation, shoaling and flushing can be avoided by using rounded corners instead of sharp turns. The construction of currently used bulkheads and several types of revetments are illustrated in Figure 5-4.

Vegetated revetments are currently recommended as a means of maintaining a vegetative fringe along the shoreline while protecting the upland (Jones, 1984). Mangroves are presently being used for this purpose in south Florida. A guide to the planting and maintenance of mangroves is available from the Florida Sea Grant Marine Advisory Program (MAP-25, Stevely and Rabinowitz, 1982).

Piers and Pilings

Mooring structures can impact water quality within the marina basin through the leaching of wood preservatives and by impeding water circulation. These potential impacts can be avoided or reduced by:

- Using alternative materials such as concrete-filled, steel-reinforced PVC, plastics or other non-conventional materials
- Using highly refined (grade one) creosote that contains less tar or alternative preservatives such as chromated copper arsenate (CCA salt) to minimize chemical leaching
- Avoid solid structures
- Elevate docks and piers as high as possible, orient in north-south rather than east-west direction and minimize structure width to allow for maximum sunlight penetration (many design guidelines call for a minimum width of 1 meter (3 to 4 ft) for finger piers and 2 meters (6 to 8 ft) for main piers.

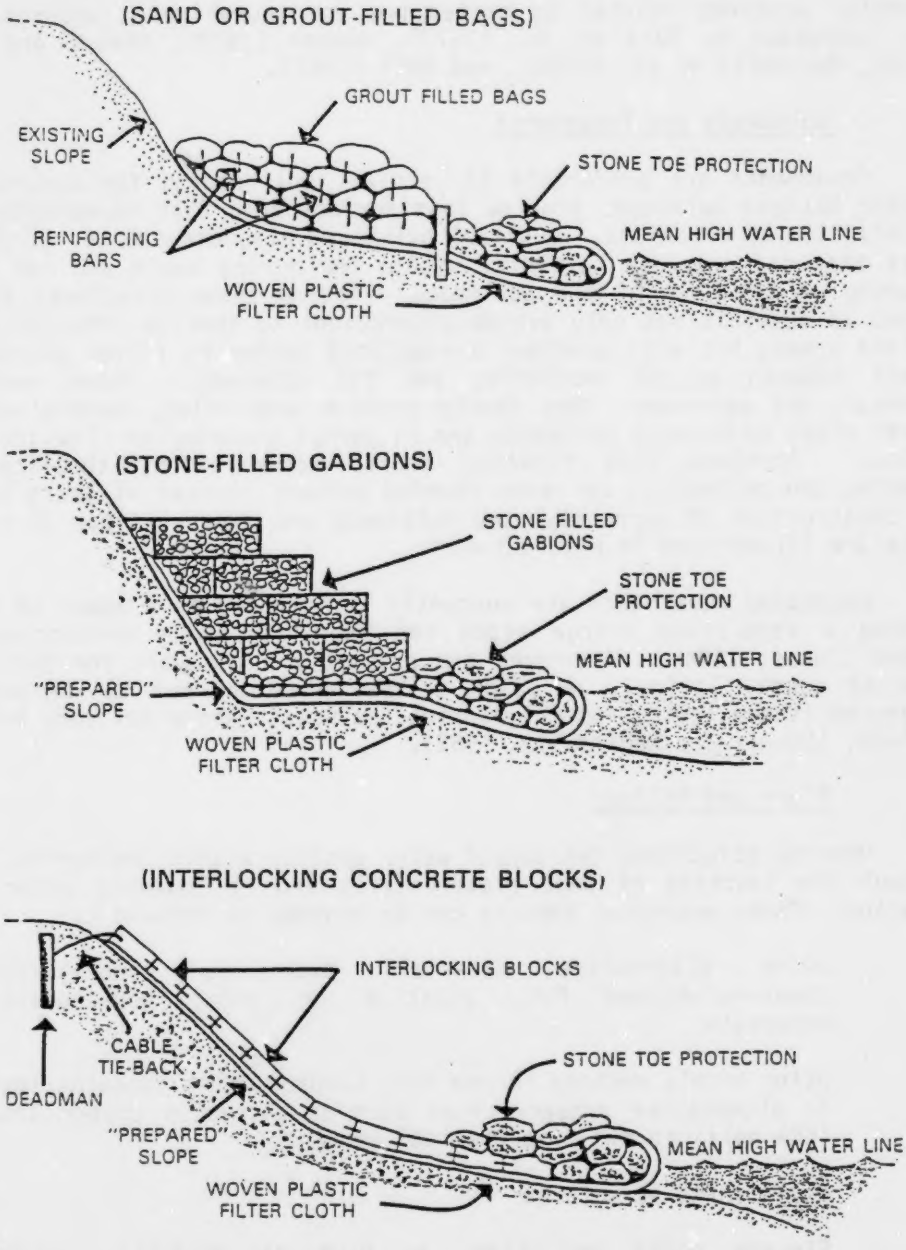
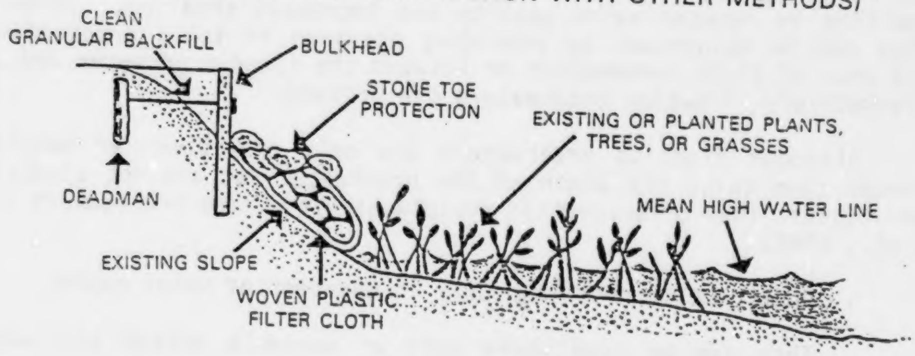
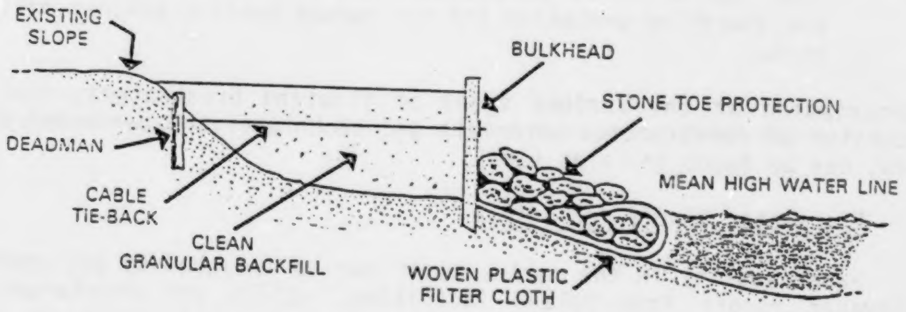

(SAND OR GROUT-FILLED BAGS)
GROUT FILLED BAGS
EXISTING SLOPE
STONE TOE PROTECTION
REINFORCING BARS
MEAN HIGH WATER LINE
WOVEN PLASTIC FILTER CLOTH
(STONE-FILLED GABIONS)
STONE FILLED GABIONS
STONE TOE PROTECTION
MEAN HIGH WATER LINE
"PREPARED" SLOPE
WOVEN PLASTIC FILTER CLOTH
(INTERLOCKING CONCRETE BLOCKS)
INTERLOCKING BLOCKS
CABLE TIE-BACK
DEADMAN
STONE TOE PROTECTION
"PREPARED" SLOPE
MEAN HIGH WATER LINE
WOVEN PLASTIC FILTER CLOTH

Figure 5-4. Examples of bulkhead and revetment structures, (USACOE, no date).

(POSSIBLY IN COMBINATION WITH OTHER METHODS)


CLEAN
GRANULAR BACKFILL
BULKHEAD
STONE TOE
PROTECTION
EXISTING OR PLANTED PLANTS,
TREES, OR GRASSES
DEADMAN
MEAN HIGH WATER LINE
EXISTING SLOPE
WOVEN PLASTIC
FILTER CLOTH

(STEEL, TIMBER, CONCRETE)


EXISTING
SLOPE
BULKHEAD
STONE TOE PROTECTION
DEADMAN
MEAN HIGH WATER LINE
CABLE
TIE-BACK
CLEAN
GRANULAR BACKFILL
WOVEN PLASTIC
FILTER CLOTH

(STONE RIPRAP)

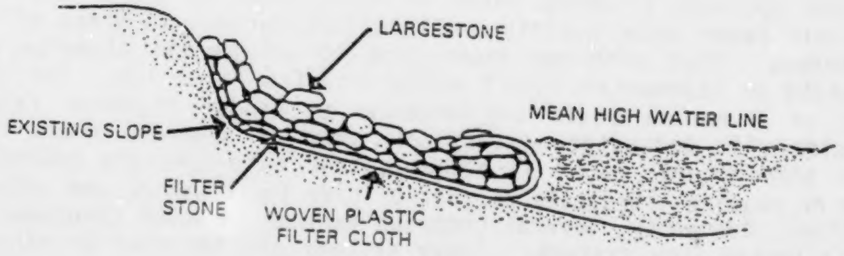

LARGESTONE
MEAN HIGH WATER LINE
EXISTING SLOPE
FILTER
STONE
WOVEN PLASTIC
FILTER CLOTH

Figure 5-4 (continued). Examples of bulkhead and revetment structures, (USACOE, no date).

Breakwaters

Breakwaters can be fixed or floating. Fixed breakwaters can interfere with currents and reduce the flushing rate within the marina, resulting in reduced water quality and increased shoaling. Circulation often can be maintained by providing openings in solid breakwaters, at both ends of fixed breakwaters or between the fixed breakwater and shore. Alternatively, floating breakwaters can be used.

Although floating breakwaters are only effective for wavelengths shorter than twice the width of the breakwater and are not effective on open coasts, they offer certain advantages over fixed breakwaters (Rogers et al., 1982):

- Construction cost is nearly independent of water depth
- They can be used where soft or unstable bottom precludes the use of fixed structures
- They can be easily relocated if necessary
- They can minimize potential interference with fish migration and shoreline processes and can reduce benthic habitat modification.

A description of the various types of floating breakwaters, including discussion of construction materials and techniques and performance analyses, can be found in Hales (1981).

Stormwater Runoff and Spills

Water quality in the marina basin can be impacted by pollutants in stormwater runoff from upland facilities, spills and discharges from boats. These pollutants include: sediment, nutrients, petroleum hydrocarbons, metals and bacteria.

Through optimal site selection, many of the problems associated with sanitary waste or other pollutants in stormwater runoff can be avoided or minimized. Marinas sited on estuaries, creeks, and waters characterized by high flushing rates or high rates of water exchange should exhibit fewer water quality problems than marinas in areas of low water exchange. High exchange rates tend to dilute and disperse any sanitary waste or stormwater runoff pollutants from a marina. The configuration of a marina basin may enhance or hinder flushing rates. Marina basins with backwater, excessively deep or dead-end areas that have lower than natural rates of exchange tend to accumulate potential pollutants or require inordinate periods of time for flushing and organic decomposition. Presently, several proposed marinas in South Carolina are designed as locked-flow systems. These systems are intended to enhance flushing through the marina basin to maintain water quality (principally dissolved oxygen). These locked-flow systems also serve to contain pollutants in the event of a spill.

An effective marina design and stormwater management plan are essential to maintaining water quality within the marina. Stormwater runoff impacts can be mitigated through proper control measures incorporated during marina design. Mitigative measures that can be used are:

- Minimize clearing and retain or create vegetated buffers such as marsh, mangrove or natural vegetation on the site between land and water areas (Chmura and Ross, 1978)
- Install erosion and sediment controls before upland construction begins
- Use porous surfaces (crushed stone, shell) wherever possible, particularly in parking areas
- Retain at least the first inch of rainfall and route runoff through swales, wetlands, retention and detention ponds and other systems that will increase the time of concentration for pollutants, decrease runoff velocity, increase infiltration and allow suspended solids to settle and remove pollutants (Boozer, 1979)
- When outfalls are necessary they should be located to discharge into areas with high flushing rates (Boozer, 1979).

Florida, for example, currently requires planned unit developments (PUD) to provide retention or detention basins to handle the first one inch of rainfall. Similar policies within other USEPA Region IV coastal states can help alleviate pollution problems due to stormwater runoff.

Fuel docks and launching ramps are the primary sources for small spills of oil and fuel. Spills at fuel docks can be minimized by using fuel pumps with back pressure automatic cut-off valves. Cut-off valves should be available at the dock and in the marina.

Sanitary Wastes

If the marina is in an area where public sewer service can be obtained, this service should be used. Where septic tanks are used, they should be located in suitable soils far enough from the marina basin and adjacent waters and designed with sufficient capacity to prevent the leaching of contaminants. Wastes from boat pumpouts should be handled separately as the chemical disinfectants used can destroy the bacteria necessary to decompose wastes in onshore treatment facilities.

Shoreside Facilities

Connection to a central sewage system is the best way for a marina to avoid potential problems with pollution from land-based sewage facilities. Connection to municipal systems may not be available at all potential or proposed marina sites, however. In such cases, septic tank systems are a viable alternative as other forms of waste treatment can be prohibitively expensive for such relatively small businesses as marinas.

Septic tanks are more effective if consideration is given to the needed size of the septic tank and its drainfield based on present and future projections of the number of people that would use the facility. A minimum drainfield setback of 100 feet (preferably more) from surface waters is recommended, as is a minimum water table depth of four feet. In addition, soil classification and percolation tests and establishment of maximum percolation rates are required in some states.

Where a municipal sewage system is not available, a problem of how best to treat holding tank wastes from boats (Type III MSDs) may arise. The problem is that most methods of waste treatment rely on the biological breakdown of wastes. Chemicals from Type III MSDs may retard or stop the desired biological decomposition (Rogers and Abbas, 1982). Connection to a municipal sewer system solves the problem of dilution of these chemicals, whereas a septic tank may not. Failure of the septic tank could result. One solution to this problem is to use two septic tanks in series for both pumpout and marina use (Rogers and Abbas, 1982). A properly installed double septic tank system would segregate solids in the first tank, reduce the chance of drainfield clogging, and increase retention time in the tanks, thus allowing for more complete waste decomposition. The installation of a septic tank exclusively for boat waste is not currently justified by the level of demand for pumpouts. In addition, a system exclusively for use for pumpout wastes would stand a greater chance of failure than a double tank system because its chemical input would be relatively undiluted and would result in a more rapid rate of filling (Rogers and Abbas, 1982). Present rates of pumpout usage are low enough, however, for a properly installed and functioning single septic tank system to handle three to four pumpouts per day (Rogers and Abbas, 1982).

Sanitary Wastes from Boats

Controlling sanitary wastes from boats is one of the primary marina permitting issues that may arise for marinas proposed in the vicinity of shellfishing waters, because of the potential impacts to shellfish through bacterial contamination. This source of pollution also can potentially result in contraventions of state water quality standards. Because of these regulatory concerns, proper management plans and designs for these wastes can be critical to marina development. In general, marina sanitation can be considered to have two components; the first is the equipment on board a vessel and the second is the onshore equipment, including piers. The onboard equipment is categorically referred to as marine sanitation devices, or MSDs.

One means of controlling sewage pollution from boats would be to educate boaters about the potential health hazards associated with the discharge of sewage and to encourage boaters not to discharge either treated or untreated wastes into a marina basin. Marina operators or harbor masters could post regulations prohibiting the discharge of any waste into marina waters and frequently inform their clients of such regulations. Such a regulation would be helpful in preserving water quality. It also makes good business sense to maintain an aesthetically pleasing appearance.

Prior to the enactment of legislation requiring MSDs on boats with heads, it was believed that MSDs would sharply reduce or eliminate the potential for shellfish contamination (Chmura and Ross, 1978). In order to assure that Type I and II MSD use is not conducted in marina waters or other restricted waters (such as bathing areas or shellfish areas), it is necessary to enforce MSD regulations. Since enforcement has been a difficult problem for the Coast Guard, an extensive public information program directed at the boating public may be effective (Boozer, 1979). Such a program could explain federal and state regulations and policies, identify restricted areas for sewage discharge, and inform the public of the public health and ecological consequences of discharging raw or treated sewage into shallow estuarine waters. Marina operators could inform their clients of restricted areas or distribute information as slips or dry storage spaces are rented.

Boat toilet use would be reduced if marinas discourage live-aboards and provide well-maintained shoreside restroom facilities of sufficient quantity to accomodate above average boating populations. Shoreside facilities must be convenient to the docks (Chmura and Ross, 1978). USEPA does not require a National Pollutant Discharge Elimination System (NPDES) permit for: "Any discharge of sewage from vessels, effluent from properly functioning marine engines, laundry, shower, and galley sink wastes, or any other discharge incidental to the normal operation of a vessel." However, this exclusion does not apply to permanently moored vessels (Olmstead, 1982). Permanently moored vessels could be discouraged from marinas in order to avoid potential discharge problems. The states also have the option to prohibit the discharge of any sewage from all vessels into aquatic habitats by applying to the USEPA Administrator for issuance of a regulation prohibiting discharge into well-defined shellfish growing waters. Applications have not been filed by any state with the Administrator, apparently because enforcement of the regulation would be defined as a state responsibility (Olmstead, 1982). Enforcement could be supported by the public education program mentioned above.

The installation and use of pumpout facilities should be encouraged. Some of the states within USEPA Region IV are presently requiring pumpout facilities for new marinas and in conjunction with permit renewals. Voluntary pumpout facility installation may avoid future efforts to require them by regulations (Rogers and Abbas, 1982). Virginia and other states now require all marinas to have pumpout facilities. North

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Carolina recently repealed its requirement for pumpout facilities at new marinas, primarily because of their low utilization rate (Rogers and Abbas, 1982). It is possible to construct small, portable pumpout systems having hand-operated or small electric pumps. Rogers and Abbas (1982) reported that the North Carolina Sea Grant program constructed a 30-gallon portable transfer tank with hand pump for 250 dollars. If sewer connections had been in close proximity to the boat slips, they concluded that a workable system consisting of only a hand pump and enough hose to reach the connection could be built for only 125 dollars. Such portable systems offer marina clients the additional advantage of providing a spare bilge pump when needed (Rogers and Abbas, 1982). Small portable systems would eliminate the need for heavy duty commercial systems until their expense was justified by demand. Manufacturer recommendations and design guidelines also are readily available for individual slipside connection systems.

Marine Sanitation Devices (MSDs)

Onboard marine sanitation devices (MSDs) are normally classified as Type I, Type II, or Type III. Type I and II MSDs treat and discharge the wastes to the water body. Type III devices are onboard holding tanks which must be periodically emptied to an onshore facility.

Type I devices only macerate and disinfect the waste. The waste is discharged immediately after treatment. There is no onboard storage of the waste.

Type II devices provide more complete treatment of the waste than Type I devices before discharge to the water body. Type II devices, however, normally include solids storage facilities as an integral part of the treatment system.

Type III MSDs can be simple holding tanks or can provide varying degrees of treatment followed by storage in a holding tank. Typically the holding tanks are emptied by shoreside pumpout.

Marina Wastewater Collection Systems

Onshore marina sanitation facilities for collection of sanitary wastes from boats are most readily compatible with Type III MDSs that must dispose of raw or treated wastes. Although Type I and II MSDs discharge directly to a water body, the Type II MSDs may require periodic pumpout of sludges accumulated in the treatment of wastes. It is possible for vessels with Type I and II MSDs to utilize a slipside marina wastewater system while berthed and connected to the system. Upon leaving their slips, however, the vessels' MSDs will discharge into the receiving water body.

Three types of onshore marina wastewater collection systems are available:

- Marina-wide systems
- Portable/mobile systems
- Slipside systems.

Marina-wide wastewater collection systems include one or more centrally located wastewater pumpout installations. These installations are located at the end of a berthing pier or on a non-berthing pier (such as a fueling pier). Vessels requiring the wastewater pumpout services would dock at the pumpout installation and a flexible hose would be connected to a wastewater fitting in the deck of the vessel.

Several firms manufacture marina-wide systems. Vacuum units are manufactured by Envirovac and positive displacement diaphragm pump units are manufactured by Kenton Equipment Company (Pump-A-Head; Figure 5-5) and by Marland Environmental Systems, Inc. (Deluxe Sani-Station). All of these units are driven by electric motors. Marina-wide systems are readily available and in widespread use. These units pump to an onshore holding tank (or truck) or to an onshore wastewater collection and treatment system.

Portable/mobile systems are similar to marina-wide systems except that the pumpout stations are mobile. The mobile unit includes a positive displacement pump and a small storage tank. The unit is connected to the deck fitting on the vessel and wastewater is pumped from the vessel's holding tank to the storage tank attached to the pumping unit. When the storage tank is full, the contents are discharged into onshore collection or treatment facilities.

Portable/mobile pumping units can be driven by electric motors or gasoline engines. Marland Environmental Systems, Inc. manufactures two models: The Mobile Sani-Station and the Portable Sani-Station. This type of system is widely available and in general use.

Slipside systems provide continuous wastewater collection facilities at each slip. In general, there are two types of slipside systems, each with modifications available to customize the system. Pumpout systems use an onboard grinder pump to transport wastes to a main sewer.

Vacuum systems use differential pressure to transport the wastewaters from each slip to a central collection tank from which wastewater may then be pumped to a sewer or hauled to a wastewater treatment plant. Both types of systems can also handle bilge water discharged from boats if the flow rates do not exceed a specified volume. The system may be used on either floating or fixed docks (Figure 5-6).

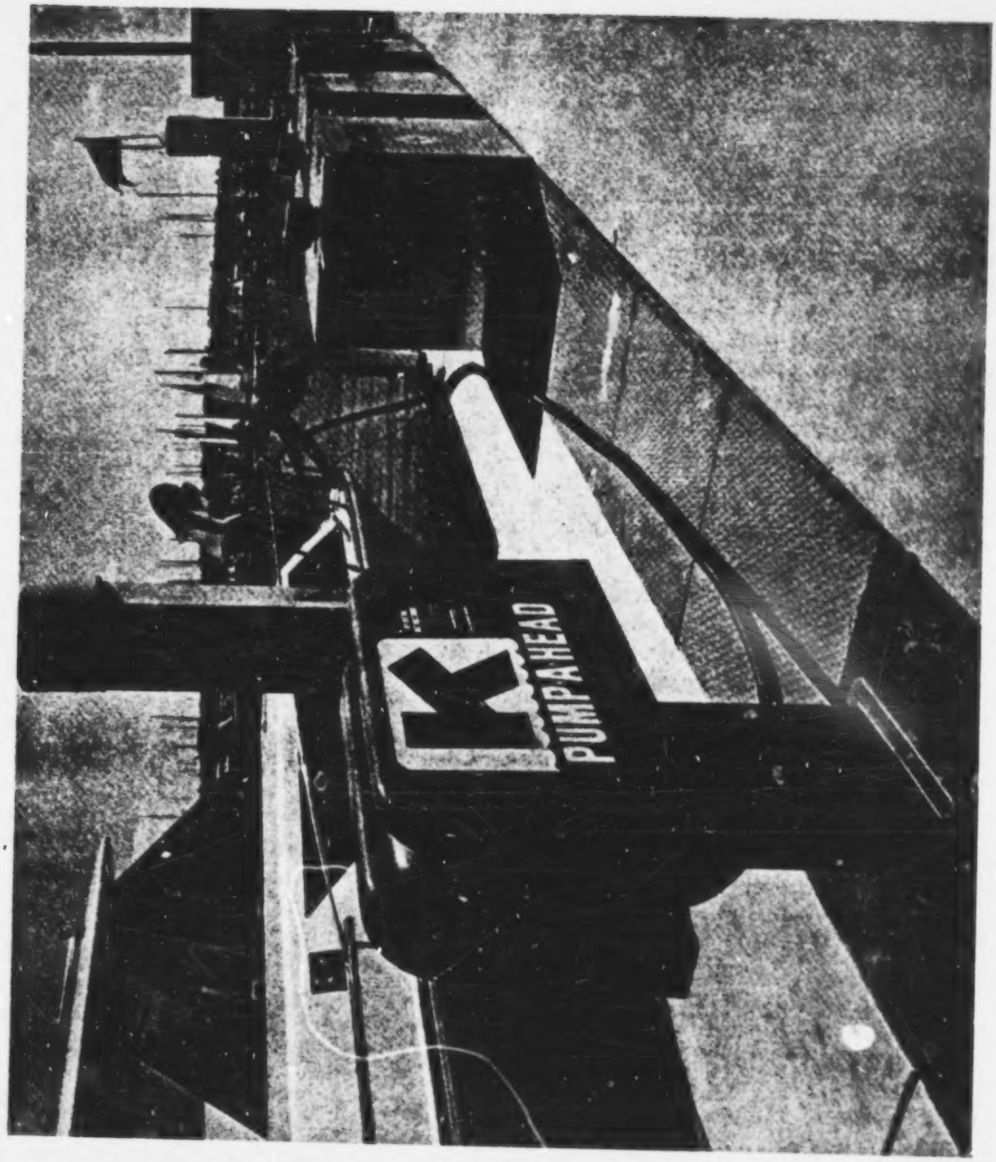

K
PUMPAHEAD

Figure 5-5. A sanitary holding-tank pumpout facility (Courtesy of Kenton Equipment Company).

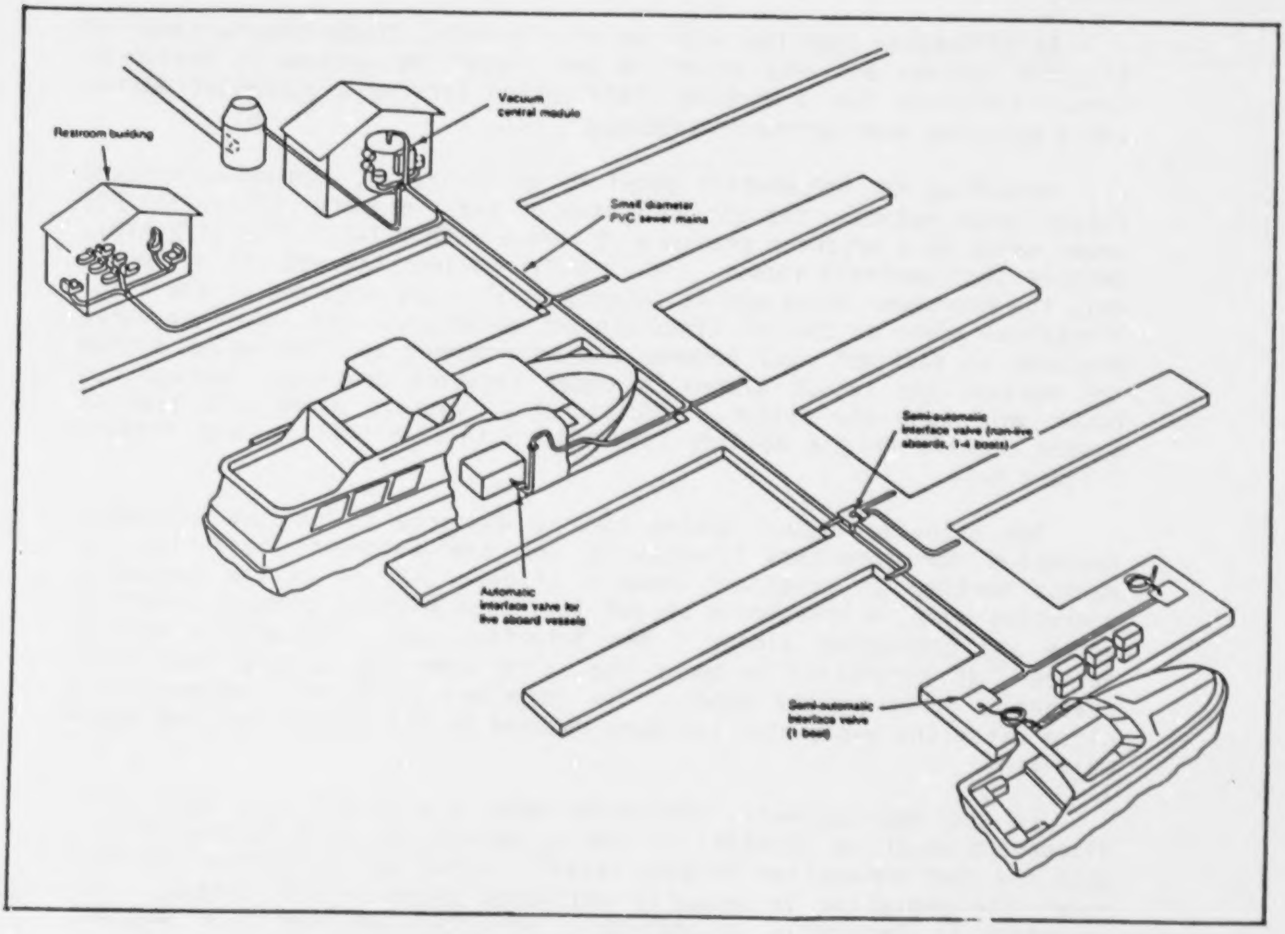

Restroom building
Vacuum central module
Small diameter PVC sewer mains
Semi-automatic interface valve (non-live aboards, 1-4 boats)
Automatic interface valve for live aboard vessels
Semi-automatic interface valve (1 boat)

Figure 5-6. Representation of the various elements of the ENVIROVAC marina system, (ENVIROVAC, 1984).

Slipside systems have been used on only a very limited basis in the United States. Generally, these systems have been custom fabricated by marina owners in various locations to meet the specific needs of a marina. Information on these systems is not generally available and the systems do not necessarily comply with any industry or regulatory standards.

As of October 1984 the only identified United States manufacturer of slipside systems actively promoting and installing systems is Envirovac Corp. Envirovac has a working installation serving a houseboat marina and a sporting boat marina in Vancouver, B.C.

According to information provided by Envirovac, centrally located vacuum pumps maintain the entire system of small diameter (2" or 3") PVC sewer mains at a negative pressure of approximately 7-1/2 PSIG (1/2 ATM). Because the (central) vacuum (Figure 5-7) provides the motivating force, only the PVC sewer mains and an interface valve are required at the slip. Electrical power or control lines are not necessary. The interface valve provides an airtight seal between the environment and the vacuum system and because the vacuum system is under negative pressure, leakage can occur only into the system. Additionally, vessels using this type of system require only a holding tank with a through hull or deck fitting (Figure 5-8).

The slipside vacuum system can be designed to include automatic operation for long-term liveaboards and semi-automatic operation for marina berthed or transient vessels (Figure 5-9). In the automatic operating mode, a liveaboard vessel is fitted with an onboard interface valve and connecting piping. The interface valve includes a sensing device that automatically opens the valve when the holding tank level reaches a predetermined depth. The interface valve will automatically close after the wastewater has been removed by the vacuum into the sewer main line.

In the semi-automatic operating mode, a flexible hose with quick disconnect couplings (Kamlok) is used to connect the interface valve unit with the deck connection on each vessel. After the connection has been made, the operation is manually activated using a push button. The operation is terminated automatically when the tank has been emptied. Two semi-automatic interface valves are available, one that services a single boat and one that can service from one to four boats (Figure 5-10).

The couplings used to connect a vessel's holding tank to the slipside system can be any number of existing manufactured units. It may be necessary for a marina to have a supply of various fittings to insure that all vessels utilizing a marina can be properly connected. Figures 5-11 through 5-12 illustrate several examples of fittings and deck or hull connections.

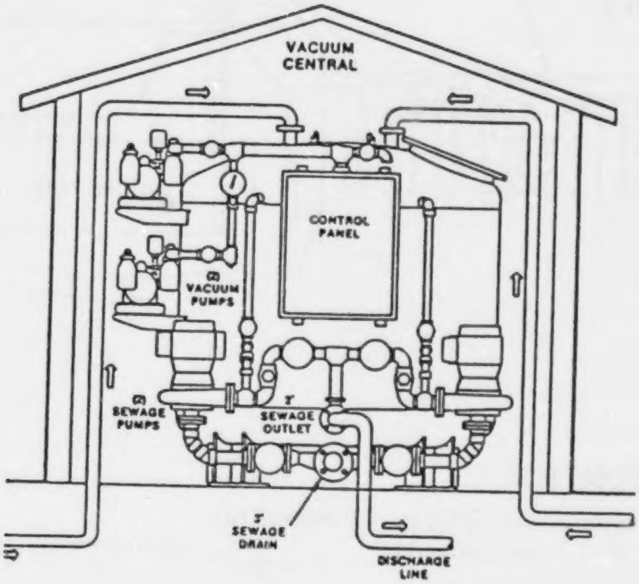
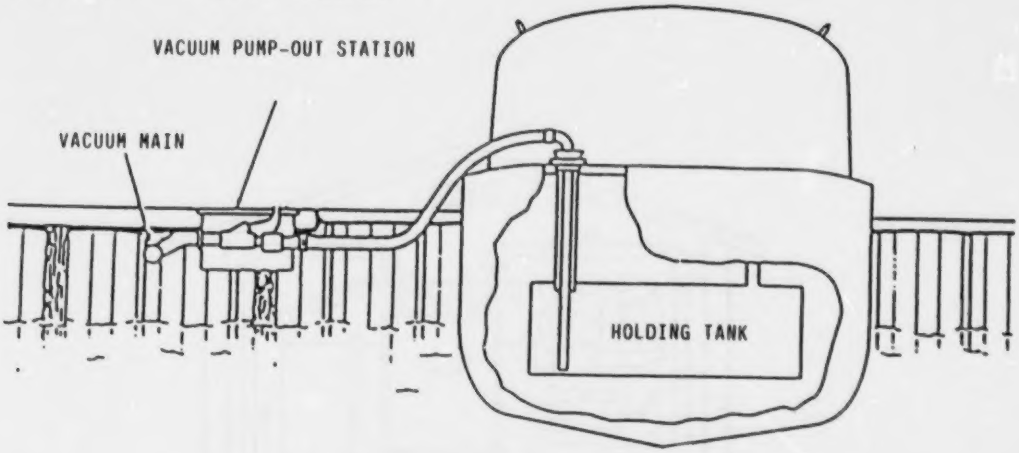

VACUUM CENTRAL
CONTROL PANEL
(2) VACUUM PUMPS
(2) SEWAGE PUMPS
3" SEWAGE OUTLET
3" SEWAGE DRAIN
DISCHARGE LINE

Figure 5-7. The Center of the ENVIROVAC System, the Vacuum Central Station (ENVIROVAC,1984).

AUTOMATIC

SERVICES: Live-aboards


VACUUM PUMP-OUT STATION
VACUUM MAIN
HOLDING TANK

SEMI AUTOMATIC

SERVICES: Transient Boats, 1 Connection
Non Live-aboards,
1-4 Boats

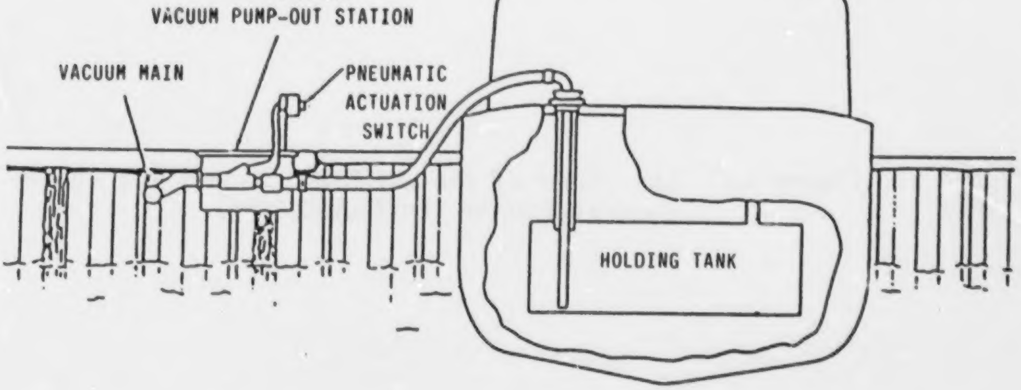

VACUUM PUMP-OUT STATION
VACUUM MAIN
PNEUMATIC ACTUATION SWITCH
HOLDING TANK

Figure 5-8. Automatic vacuum pump-out stations, (ENVIROVAC, 1984).

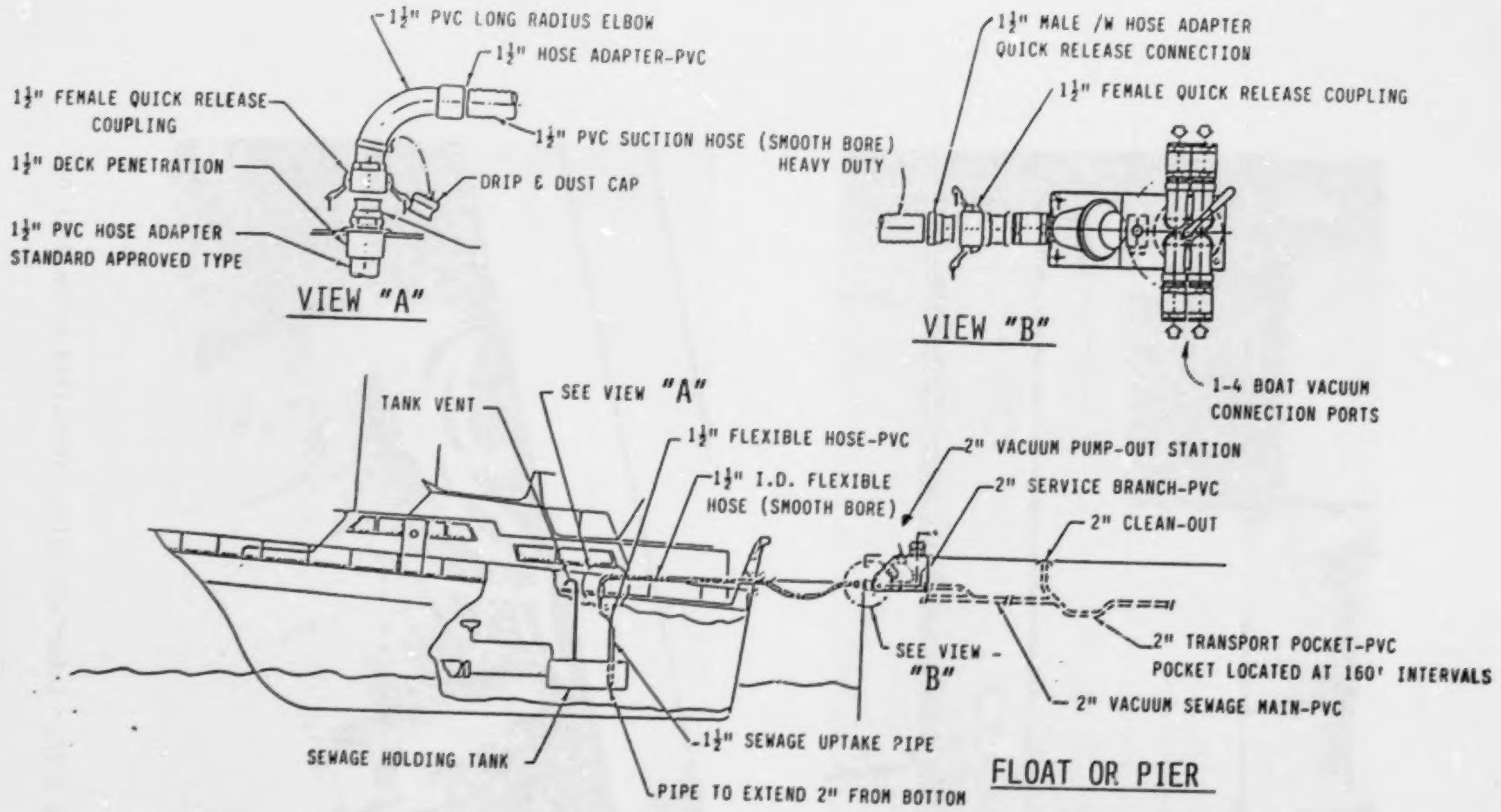

1½" PVC LONG RADIUS ELBOW
1½" HOSE ADAPTER-PVC
1½" FEMALE QUICK RELEASE COUPLING
1½" PVC SUCTION HOSE (SMOOTH BORE) HEAVY DUTY
1½" DECK PENETRATION
DRIP & DUST CAP
1½" PVC HOSE ADAPTER STANDARD APPROVED TYPE
VIEW "A"
1½" MALE /W HOSE ADAPTER QUICK RELEASE CONNECTION
1½" FEMALE QUICK RELEASE COUPLING
VIEW "B"
1-4 BOAT VACUUM CONNECTION PORTS
TANK VENT
SEE VIEW "A"
1½" FLEXIBLE HOSE-PVC
1½" I.D. FLEXIBLE HOSE (SMOOTH BORE)
2" VACUUM PUMP-OUT STATION
2" SERVICE BRANCH-PVC
2" CLEAN-OUT
2" TRANSPORT POCKET-PVC POCKET LOCATED AT 160' INTERVALS
SEE VIEW - "B"
2" VACUUM SEWAGE MAIN-PVC
SEWAGE HOLDING TANK
1½" SEWAGE UPTAKE PIPE
PIPE TO EXTEND 2" FROM BOTTOM
FLOAT OR PIER

Figure 5-9. Typical Marina Boat Hook-Up for a Vacuum Sewage Collection System (ENVIROVAC, 1984).

SINCE PROPER FUNCTIONING OF THE EQUIPMENT IS DEPENDENT UPON THE DESIGN OF THE VACUUM SYSTEM, ENVIROVAC ASSUMES NO RESPONSIBILITY FOR THE PERFORMANCE OF THE EQUIPMENT UNLESS GIVEN AN OPPORTUNITY TO REVIEW ALL DRAWINGS AND DESIGN DATA RELATIVE TO THE VACUUM SYSTEM AND THE SYSTEM IS INSTALLED IN ACCORDANCE WITH ITS RECOMMENDATIONS.

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ENVIROVAC INC.
1260 Turret Dr. • Rockford, Il 61111

TITLE VACUUM SEWAGE COLLECTION SYSTEM
TYPICAL MARINA/BOAT HOOK-UP

REL NO.
DR BY KG 9-13-79
CHK'D BY RC 9-13-79
SCALE
APPV
MAT'L

REV | CHG ORDER NO | DATE | DESCRIPTION | CHK'D BY

ENVIROVAC vacuum sewage systems
SHEET SIZE C
DWG NO 2700803
SHEET 1 OF 1

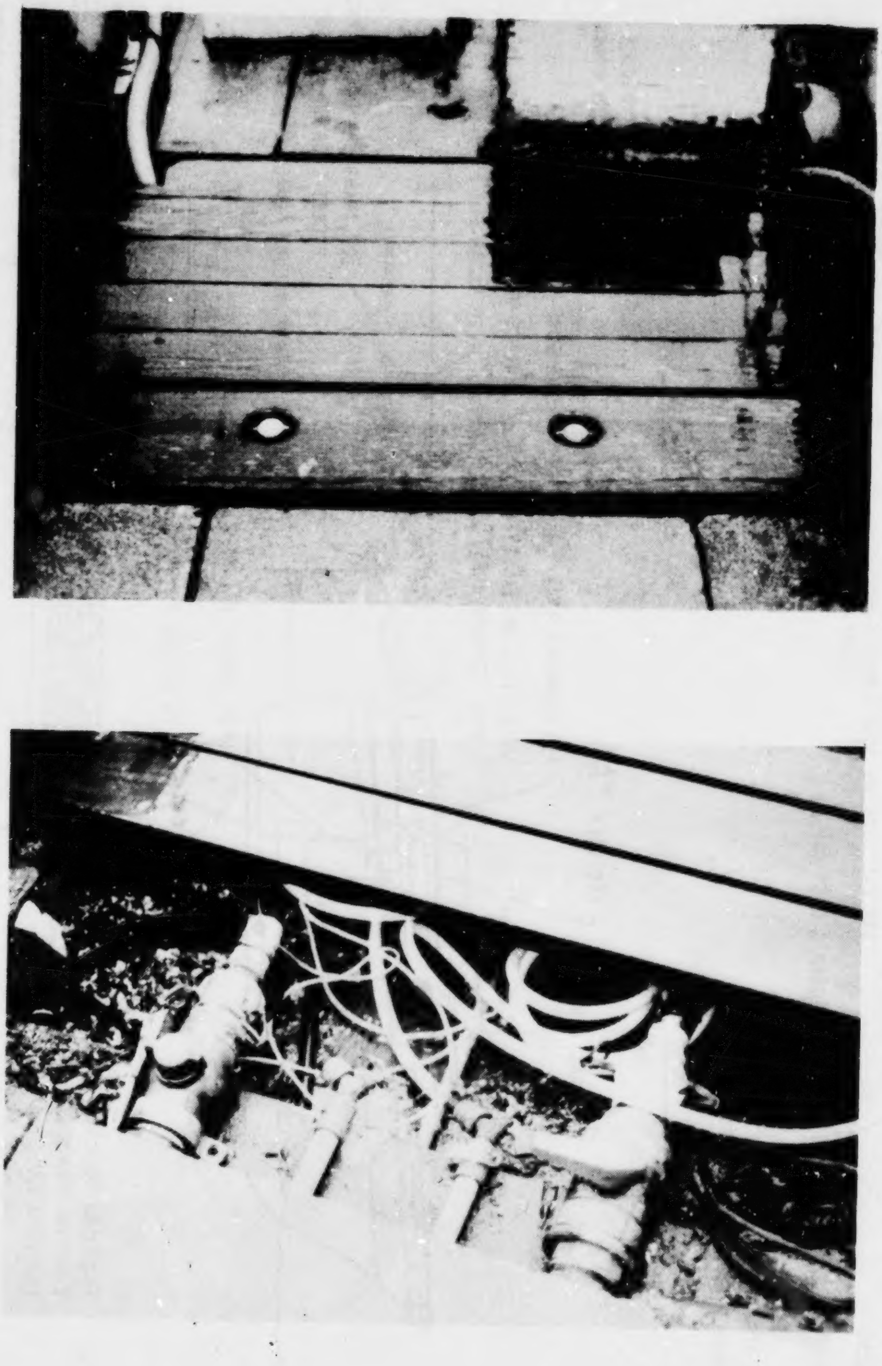

Figure 5-10. Interface valves installed below decking.

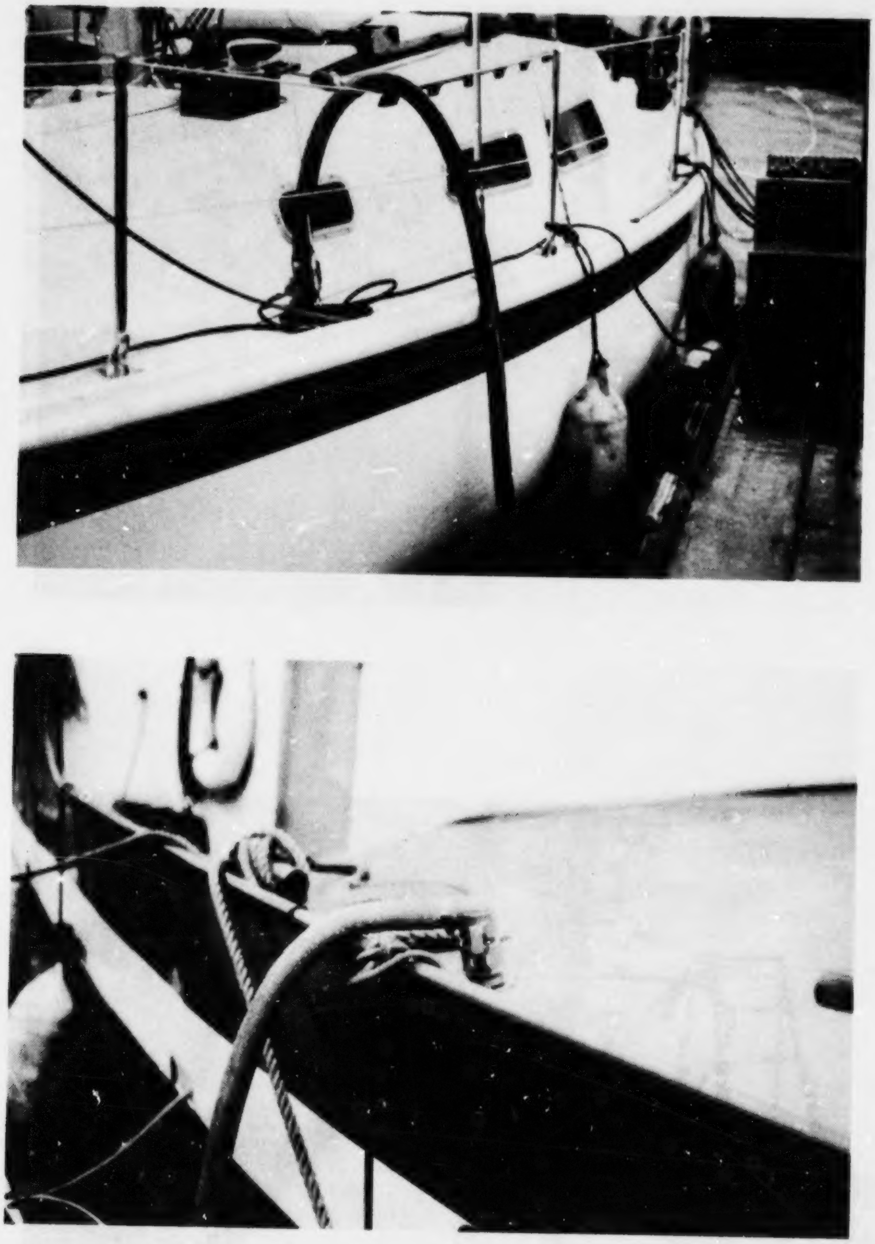

Figure 5-11. Examples of deck connections.

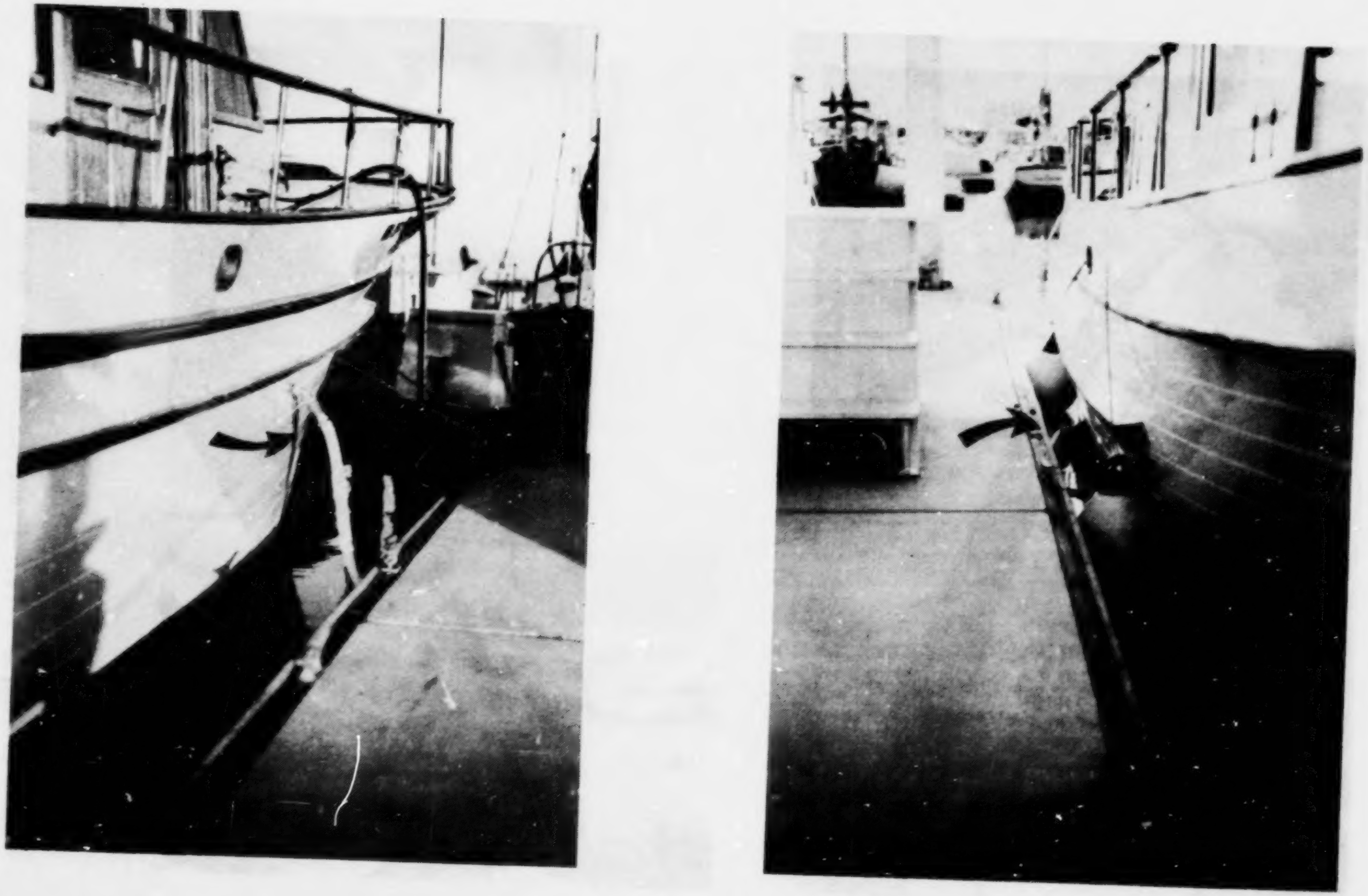

Figure 5-12. Examples of through-hull connections.

System Characteristics

The three types of collection systems outlined previously (marina-wide, portable/mobile, and slipside) all have advantages and disadvantages. The marina owner should consider the operational and environmental aspects of each, as well as the associated costs, before selecting a system. Characteristics of each system are summarized in Table 5-2.

System Costs

Tables 5-3 and 5-4 summarize the construction or installation costs (capital costs), annual operation and maintenance costs, and total annual costs associated with the three types of collection systems. The capital costs are highest for the slipside system because of the extensive network of piping necessary to collect the wastewater. The annual operation and maintenance costs are highest for the portable/mobile system because of the higher labor requirement associated with moving the pumpout equipment to each boat. These costs are based on calculation procedures and assumptions provided in Appendix B.

The costs of ultimate disposal of the wastewater as well as the costs of fitting or refitting of vessels are not included in Tables 5-3 and 5-4. It is assumed that these costs will be the same for the three types of collection systems considered here.

Overall Comparison of Systems

The collection systems discussed above can all provide effective, reliable means of removing wastewaters from boats. The major differences are the degree of convenience to the boat owner and the costs for both initial construction and operation and maintenance. Table 5-5 is a summary of the major characteristics.

All other things being equal, the marina developer will tend to choose that system which provides the degree of convenience acceptable to the clientele he intends to serve, and which is within his financial resources at the time of construction.

Marina slip rentals are highly variable and dependent on several factors. They are dependent on the competition for slip space, the overall cost of materials, labor, and services at the marina, and the variety of services provided by the marina. This last factor is the most significant. Basic marinas provide slip only, while others provide a wide variety of maintenance (e.g., repair facilities, shops) and recreational services (e.g., tennis courts, swimming pools).

Slip rentals for continuous usage range from as low as $300/year to as much as $15,000/year. For a basic marina with minimal services, wastewater collection services could add as much as 50 percent to the cost of slip rentals. At highly developed full service marinas,

TABLE 5-2

CHARACTERISTICS OF MARINA WASTEWATER COLLECTION SYSTEMS

Type	Implementability	Reliability and Operability	Disruption and Convenience
Marina-Wide	Applicable to all marinas. Moderately convenient to retrofit to existing marinas. Non significant vessel retrofit needed.	Moderately reliable depending upon the level of operator attention. Easy to take out of service during non-use or under severe conditions.	Least convenient system. Requires vessels to move to the discharge installation. Very inconvenient for live-aboards. Not applicable to houseboats. Adds to noise and congestion in the marina.
Portable/Mobile	Applicable to all marinas with sufficient pier integrity. Very convenient to retrofit to existing marinas. No significant vessel retrofit needed.	Most reliable since the equipment can be removed for service at shop. Reliability increased with additional back-up units available. Easier to operate. Requires most manpower because of necessity to move the pumping equipment.	Moderately convenient. Boat owners may find it difficult to wait for the unit to provide service to the slip. Scheduling difficulties.
Slipside	Marina configuration may limit application. More difficult to retrofit for existing marinas. Requires addition of special fittings to vessels.	Least reliable because of the extensive piping and valving. Requires least amount of operator attention. Most difficult to take out of operation under severe conditions.	Most convenient and least disruptive. Most practical system for live-aboards and houseboats.

COASTALIX
TABLE 1

TABLE 5-3

CAPITAL COSTS (CONSTRUCTION AND EQUIPMENT)

	Marina-Wide	Portable/Mobile	Slipside
Small Marina (200 slips)	$20,500	$12,100	$141,000
Medium Marina (500 slips)	59,000	26,000	346,000
Large Marina (2000 slips)	218,000	96,000	1,564,000

*See Appendix B for details

COASTAL IX
TABLE 2

TABLE 5-4

ANNUAL PER SLIP COSTS (AMORTIZED CONSTRUCTION COSTS, AND OPERATION AND MAINTENANCE)

	Marina-Wide	Portable/Mobile	Slipside
Small Marina (200 slips)			
Capital cost	$ 15 (1)	$ 15 (2)	$ 102 (1)
O & M Costs	110	200	50
Total Cost/Slip/Year	125	215	152
Medium Marina (500 slips)			
Capital Costs	17	10	101
O & M Costs	90	160	40
Total Cost/Slip/Year	107	170	141
Large Marina (2000 slips)			
Capital Costs	16	10	113
O & M Costs	80	140	36
Total Cost/Slip/Year	$ 96	$150	$149

---

(1) Based on 12 percent interest, 15 years amortization.

(2) 12 percent interest, 15 years on piping, 12 percent, 5 years on portable units.

TABLE 5-5

SUMMARY OF MAJOR CHARACTERISTICS OF AVAILABLE COLLECTION SYSTEMS

Characteristic	Marina-Wide	Portable/Mobile	Slipside
First Cost	Low	Low	High
Operation and Maintenance Costs	Moderate	High (labor intensive)	Moderate
Total Annual Costs	Lowest	Highest (due to labor requirements)	Intermediate
Convenience to Boat Owner	Least	Intermediate	Most

COASTALIX
TABLE4

wastewater collection will represent as little as 10 percent of the rental cost.

The selection of a marina collection system will depend upon cost and operational factors and the level of convenience the marina elects to provide. The higher cost of the slipside system, for example, may be offset by the significantly greater convenience to the boat owner. Costs to install and operate the system will impact on the cost competitiveness of the marina. The relative costs for services at nearby marinas will affect the decision.

In the long-term, regulations may be the deciding factor in which system is used. Several municipalities have adopted ordinances or permitting systems for liveaboards or houseboats. Ordinances from Dade County, Florida, the City of Berkeley, California and Marin County, California, have been included as examples in Appendix D.1, D.2 and D.3, respectively. A summary of these ordinances appears in Section 6.5.4. In addition to the ordinances and permits, it is necessary that reasonable enforcement be conducted. Another important point that must be considered is that of federal (Coast Guard) regulations preempting local/regional or state regulations.

Existing Operational Systems

As of the date of this Handbook there were only a limited number of operating slipside wastewater disposal systems in the United States. Two areas with significant numbers of these systems are San Francisco Bay and Vancouver Granville Island. Systems in use in these areas were evaluated as to cost, function, acceptability and institutional aspects of their use.

In the San Francisco Bay Area, a state agency, the San Francisco Bay Conservation and Development Commission (BCDC), has been designated as the lead regulatory agency to guard the "people's trust" water bodies in the greater Bay area. The BCDC, through fairly detailed studies, has determined that the water quality in the water bodies under its jurisdiction has been decreasing in recent years. One of the causes of this degradation is the concentration of boats in the Bay area, including sporting boats, cruising liveaboards, anchorouts, and houseboats.

The BCDC attempted to control the discharge of wastewater from vessels utilizing a permit system requiring holding tanks on vessels and additional pumput stations and facilities at the marinas within the Bay area. The U.S. Coast Guard has vetoed this plan, informing BCDC that such a permitting process is preempted by federal laws and regulations, specifically the Federal Boating Safety Act of 1971, the Federal Water Pollution Control Act as amended, and Title 35 Code of Federal Regulations part 159.

The Coast Guard subsequently suggested that the BCDC seek U.S. Environmental Protection Agency designation for areas within the Bay as "no discharge areas." With this designation, compliance with MSD regulations in a "no discharge area" becomes the responsibility of the Coast Guard.

Marin County, north of San Francisco, contains one of the larger concentrations of houseboats/liveaboards. The county has adopted ordinances to provide zoned areas for houseboats/liveaboards, to require slipside sanitary service to those marinas that allow houseboats or liveaboards, and to require holding tanks on any vessel that may dock in Marin County and have liveaboards. A copy of the ordinance is included in Appendix D.3.

One of several houseboat marinas in Marin County is the Kappas Marina in Sausalito. Each houseboat unit has its own holding tank. When the level of wastewater in the holding tank reaches a certain predetermined level, a pump is activated and empties the contents of the tank into the common PVC sewer main under the pier. The wastewater is conveyed to an onshore pumping station where the wastewater is subsequently conveyed to the Sausalito Marin City Sanitary District for conveyance, treatment and disposal. According to the marina owner and boat users, the grinder pump is not a source of operation and maintenance problems.

In the Richardson Bay waters adjacent to Kappas Marina, another problem that has plagued marina owners and users are anchorouts. These vessels are occupied by individual(s) as liveaboards but they remain anchored offshore in open water. The vessels often appear to be run-down and generally in poor shape. The disposal of wastewater from these vessels is suspected of being discharged directly into the Bay. No solution to this problem has been developed.

The City of Richmond, California has recently redeveloped its waterfront to include luxury condominiums and a private and a public marina. The City has established, through an ordinance, that liveaboards or houseboats are not permitted. Individuals are prohibited from staying on their vessels for more than 72 consecutive hours. There are three "pump-a-heads" serving approximately 1,000 slips. The wastewater is transported by the pump-a-heads to an onshore pumping station for conveyance and treatment in the City's sewer system.

According to the marina Harbor Master, the pump-a-heads function satisfactorily but require constant minor maintenance such as diaphragm and check valve replacement. The Harbor Master functions as an enforcement officer to prevent sanitary wastes from being discharged into the Bay. Also at the Richmond City Marina bilge water disposal was perceived to be a much more serious water quality problem. The control of bilge water discharge is particularly difficult since most boats are fitted with bilge pumps by the manufacturer.

The Berkeley Marina in Berkeley, California, has 1,100 slips, including dry storage. Twelve slips are sewered slipside for houseboats or liveaboards. The marina also allows 40 additional cruising liveaboards, although the liveaboards must use the pump-a-head station. Liveaboards must enter into an agreement with the City of Berkeley to comply with the rules and regulations of the City Ordinance. A copy of the agreement and ordinance is included in Appendix D.2.

According to the agreement, a cruising liveaboard must have all through-hull fittings sealed prior to receiving a liveaboard permit. The open fittings must be resealed within one day of returning to the marina following an open water cruise.

At the Berkeley City Marina the slipside service to houseboats and liveaboards is comprised of onboard holding tanks and grinder pumps connected by various piping schemes to the sewer main along the main pier. The wastewater from the main sewer in the pier drains to another holding tank in the pier with larger pumps. These larger pumps convey the wastewater to an onshore pumping station for final conveyance and treatment.

The Peninsula Marina in Redwood City, California, has liveaboard piers and utilizes a modified holding tank/pumpout slipside sewer system. Every liveaboard slip is provided with a connection piping stub or lateral. Each vessel connects a line from the hull or deck opening to the slipside piping. Wastewater is pumped from the vessel's holding tank into the sanitary mains below the pier. The sanitary mains act as a holding tank during the day and at midnight the mains are flushed with city water and the wastes are transported to the public sewer.

Two privately owned marinas using slipside sanitary sewer service are found in the City of Vancouver, British Columbia. The first is Sea Village and is comprised of 12 houseboats and two liveaboard vessels. The second marina is Spruce Harbor and contains 100 slips, 80 of which are served by slipside service, including 64 year-round liveaboard vessels. Both marinas are located on False Creek in the Granville Island area and both utilize vacuum systems by Vacuusan (ENVIROVAC). The Sea Village houseboats have individual holding tanks and valves that are activated by preset pressure in the tank. When the valve is open, wastewater is drawn by a vacuum into a larger holding tank. When the vacuum in the individual holding tank is broken as the tank empties, the valve closes. The wastewater in the larger holding tank is pumped to onshore facilities for conveyance and treatment.

The liveaboard vessels in the Spruce Harbor Marina are required to obtain permits from the City of Vancouver each year at a cost of approximately $500. The funds from liveaboard permits represent a substitute property tax. Each liveaboard vessel is connected by a through deck or hull fitting to the marina's vacuum system. Each slip is isolated by a manually operated valve located in the finger pier. When a vessel's holding tank becomes filled, the boat owner manually opens the isolation valve, allowing wastewater to be drawn into the vacuum system. The valve is manually closed when the tank has been emptied. Wastewater drawn from a vessel is transported through a PVC main located in a pipe gallery below the pier's walkway. The wastewater is collected in a holding tank and is subsequently pumped onshore for final conveyance, treatment and disposal.

From these cases, certain conclusions concerning marina sanitation become obvious:

- Local governments/agencies use ordinances, contracts, and permits to regulate liveaboards and houseboats. The ordinances provide the necessary legal framework to require slipside service to liveaboards and houseboats
- Regulatory control of holding tank requirements may result in agency conflict
- The strongest ordinance, contract, or permit systems require constant enforcement
- Bilge water discharge may be a serious problem that is not being addressed
- Systems operate without major problems, including self-fashioned systems. Boat owners do not complain of inconvenience or expense
- Costs are not readily obtainable for slipside service. Marina owners/operators do not separate this specific sevice from total costs of marina operation.

Boat Operation and Maintenance

Boat motor emissions can be reduced through the increased use of unleaded fuels and by manufacturer research and development aimed at reducing the pollutants in emissions and increasing fuel efficiency. Public education directed toward the importance of well-tuned engines in reducing emissions and increasing efficiency is another mitigative measure to be considered. Relevant to noise mitigation, manufacturers have made significant progress in reducing the noise levels of boat engines. At marinas, consideration must be shown to both neighbors and customers. If necessary, posting and enforcing rules can be used to limit noise.

Use of the newer non-phosphate detergents for washing boats would greatly reduce the amounts of nutrients entering the water from this source. Hydrocarbons entering the water from bilges may be controlled by using oil filtration devices on bilge pumps, or commercial oil-absorbant pads placed in the bilge to soak up oil and fuel prior to bilge water discharge (Chmura and Ross, 1978). Fuel spills at marinas are generally very small, but they may be frequent. Contamination from fuel spills may be avoided through training fuel attendants to prevent and to clean up any fuel spills. Fueling of ramp-launched boats before launching would prevent spills directly into the water.

Paint spraying, sand blasting, engine repairs, boat washing and similar boat maintenance activities performed on shore either indoors or behind canvas screens would help confine any residue or spills from these operations. These operations should be conducted upland, away from marina waters. This would facilitate clean-up and help prevent contamination of marina waters from runoff during rain storms.

Manufacturers need to develop antifouling paints which will reduce or eliminate the amount of heavy metals such as copper that leach into the water or flake off boat bottoms (Nixon et al., 1973). Sieburth and Conover (1965) have described the preliminary development and testing of an antifouling paint based on the antibiotic activity of sea weed.

Marina operators can reduce copper levels by eliminating the use of copper-based antifouling paints on floats, buoys, and other non-boat surfaces. This step may encourage additional fouling. However, these fouling communities are an important food source for forage fishes which, in turn, attract sport fishes into the area. Another desirable pollution control option is to collect and remove particles or otherwise treat the runoff from boat painting and scraping areas. Copper concentrations within the marina, as with detergents, sewage, and other pollutants, also can be reduced by proper marina siting and design that allows adequate tidal flushing.

5.4.2 Ecological Mitigative Measures

Aquatic Habitat

Maintaining water quality through the design and mitigative measures previously discussed is essential to maintaining the aquatic habitat in the vicinity of the marina. Construction impacts to aquatic habitats result from increased turbidity and siltation and from direct habitat loss due to dredging. Alteration of the shoreline through dredging and placement of structures also can damage the aquatic community and even eliminate the shallow intertidal zone. Recolonization of dredged areas or disposal sites is more likely to occur when the sediments in either area are similar in physical and chemical characteristics both before and after dredging or disposal. Mitigative measures applicable to aquatic habitat resources are:

- Locate marinas on existing channels
- Avoid sensitive areas such as shellfish beds and grassbeds
- Minimize the need for dredging through choice of marina site and design and the use of dry-stack storage for boats
- Extend open dockage to reach deep water
- Depth requirements should be based on the size and type of boats serviced and should not exceed the zone of light penetration unless existing conditions already exceed that depth
- Schedule dredging and other construction activities at times other than during spawning, migration or critical life stages of fish and other aquatic organisms. Critical periods vary with geographic location, e.g., recommendations to mitigate impact on recruitment in South Carolina, for example, are for late and/or early winter dredging (Van Dolah et al., 1979)
- Use sediment curtains and coordinate dredging activities with tidal cycle so as to avoid excessive siltation and burial of sensitive organisms
- Minimize pier widths to avoid excessive shading of aquatic habitats
- Place bulkheads or revetments as far upland as possible and and provide access ways over wetlands to avoid shallow intertidal areas
- Use floating, detached breakwaters and floating docks or piling construction to minimize habitat loss
- Sloping revetments (stair-step or sloped 45° or less) and vegetated revetments provide better habitat and protection for juvenile fish and are preferable to vertical bulkheads, where feasible
- Locate boat ramps away from sensitive areas such as grassbeds or shellfish beds. Preferred areas are shorelines without wetland vegetation and adjacent to waters with adequate navigation depths
- Use of marine ways (dolly) and hoists can be used instead of ramps to minimize shoreline alterations (a marine way precludes the need for a pier or dredging at marinas with a gradual submarine slope and permits preservation of a vegetated fringe, while hoists require pier construction).

Unavoidable loss of habitat can be compensated through use of dredged material to provide new habitat. The planting of mangroves, marsh grasses and seagrasses has been used to restore altered habitats.

Rehabilitation of Altered Areas

When alternative sites are not available, or when some habitats are altered or destroyed during construction, some of these areas can be rehabilitated. The planting of mangroves and marsh grass (Clark, 1974; Woodhouse et al., 1971) and seagrasses (Thorhaug *in* Swanson, 1979; Zieman, 1982) are examples of artificial habitat restoration. The method of recolonization or rehabilitation chosen for these sensitive areas will depend on location, species concerned, sediment type and cost.

The disturbance of mangroves caused by dredge and fill is a particular problem for Florida. Mangrove species differ in their response to alterations of their environment. For example, black and white mangroves in Florida are typically more resistant to the effects of diking and flooding than red mangroves (Teas, 1980). Teas (1980) reports that several years of experiments have been performed on mangrove transplanting to a spoil island in Roberts Bay at Marco, Florida. The plant survival rate after three years was 15.7 percent. This low survival rate may have been partially caused by the settling of the soft fill used in forming the spoil island. Success rates will vary under different conditions. Mangrove rehabilitation/creation is a viable mitigation alternative that will necessitate site-specific research.

Woodhouse et al. (1971) discuss the stabilization of dredge spoil and the establishment of new tidal marsh using *Spartina alterniflora* Loisel in several sites in North Carolina. This technique could be applied elsewhere along the Atlantic and Gulf Coasts. Revegetation projects in South Carolina and Georgia, however, are hindered by substrates composed of clay and silt which form thick hard crusts (Windom, 1976).

Establishment of *Spartina* is possible by means of either seeds or transplants. Direct seeding apparently offers a very rapid and relatively economical route to the establishment and stabilization of areas meeting certain standards. Transplanting is considerably more expensive, but may be adaptable to a wider variety of conditions. Results from these studies have indicated complete revegetation in two growing seasons.

Since it has been shown that natural recolonization of seagrass beds takes many years and is often unlikely, rehabilitation of damaged seagrasses by means of transplanting is a mitigative measure that may be considered (Table 5-6). Thorhaug (1980) has given estimates ranging between $2,000 and $8,000 an acre after three to four years for the rehabilitation of *Thalassia testudinum* (turtle grass). These estimates were based on 7,000 plants in 15,000 m^2 using the seeding method. Thorhaug (1980) estimates marina building on navigational channels may possibly be assessed at 1:1 to 3:1 (restored acres: filled acre ratios).

TABLE 5-6

SUMMARY OF SEAGRASS RESTORATION[a]

Method	Author	Place	Shelter	Number	Anchoring method	Chemical additive	Dimension of transplant	Success	Genus
Plugs	Kelly et al. 1971	Tampa Bay, Florida	Blocks	120	1. Tin can 2. Burlap bag 3. Wrap in polyethylene for transport	NAA	20 cm^2	Control 40% Exper. 15%	Thalassia
Plugs	Van Breedveld 1976	Tampa Bay, Florida	Rows of plants	266	30 cm substrate into hole	5% NAA 5% Root dip	30 cm deep posthole digger	0-100%	Thalassia
Plugs	Van Breedveld 1976	Tampa Bay, Florida	Rows of plants	15	30 cm substrate into hole	5% NAA 5% Root	30 cm deep posthole digger	100%	Syringodium
Plugs	Larkum 1976	Mortons Bay, Australia			Dug holes				Zostera
Plugs	Phillips 1960 Reported 1975	Tampa Bay, Florida	Concrete blocks, wood barricades	Not reported	Buried with soil	None	10 cm^2	Some	Halodule
Plugs	Phillips 1960 Reported 1975	Tampa Bay, Florida	Concrete blocks, wood barricades	Not reported	Buried with soil	None	10 cm^2	None	Thalassia
Turfs	Ranwell et al. 1974	Norfolk, England	-	20	Spaded into hole	-	22X15X 10 cm		Zostera
Turfs	Ranwell et al. 1974	Norfolk, England	-	1,950 into 2.3 acres	Spaded into hole	-	22X10X 15 cm	100% yr 1 35% yr 2	Zostera Zostera

[a] Thorhaug, 1980.

TABLE 5-6
(concluded)
SUMMARY OF SEAGRASS RESTORATION[a]

Method	Author	Place	Shelter	Number	Anchoring method	Chemical additive	Dimension of transplant	Success	Genus
Turfs	Backman (unpubl)	San Diego, California	Wire screening	Not reported	Turf buried at site Screening Plastic trays	-	Not reported	Rhizomal growth	*Zostera*
Turfs	Larkum 1976	Botany Bay, Australia	-	Not reported	Dug holes	-	Not reported	-	*Zostera*
Turions	Kelly et al. 1971	Tampa Bay, Florida	Concrete block enclosures	60	Construction rods bricks, pipes	10% NAA	Single blade Group	18% in some	*Thalassia*
Turions	Phillips 1974	Whidbey Isle, Washington	None	243	Iron pipes & trenches	-	Single blade Group	Dependent on depth - 100% to none	*Zostera*
Turions	Eleuterius 1975	Biloxi, Mississippi		335 343 210	Mesh wire & and construction rods	-	45 cm X 45 cm	3% 3%	*Thalassia* *Halodule* *Cymodocea*
Seeds	Addy 1974a,b	Woods Hole, Massachusetts	None	-	None	-	Single seeds	No results reported	*Zostera*
Seeds	Phillips 1972	Friday Harbor, Washington	None	25	Iron rods & trenches	-	Single seeds	None	*Zostera*
Seeds	Thorhaug 1974	S. Biscayne Bay, Florida	None	6,000	Plastic	10% NAA	Single seeds	80%	*Thalassia*
Seeds	Thorhaug 1974	N. Biscayne Bay, Florida	None Peat pots	600	Plastic	10% NAA	Single seeds	15-55%	*Thalassia*

Zieman (1982) has reviewed studies conducted on seagrass plug/shoot transplants and seed/seedling plantings. Restoration problems included specimen acquisition, anchoring, survival, expansion, logistics and costs. The plug technique produced the highest survival rate (90-98 percent) but costs were estimated between \$27,000 and \$86,500/ha. In addition, areas disturbed by removing plugs were slow to be repopulated by seagrass, as was the case with boat propeller cuts in seagrass beds. Recolonization of plug holes had not occurred after two years. However, this method could be useful if seagrass plants were salvaged from grass-beds scheduled for destruction due to development. Laboratory-cultivated seeds/seedlings exhibited moderate survival (29 percent) but costs were prohibitive. Primarily because of laboratory culturing expenses, this method cost approximately \$182,900/ha. Seeds/seedlings also were only suitable for quiet water areas where they would not be uprooted. Thorhaug (1980) has had success in restoring certain south Florida areas using turtle grass (Thalassia testudinum) seedlings. A summary of many seagrass transplantation techniques and locations is provided in Table 5-6.

Although these accounts show some success, problems involving cost and restoration time exist, so avoiding or minimizing impacts to sensitive aquatic habitat resources is the primary mitigative measure.

Existing marinas and other sites that flush poorly also can be rehabilitated. In lieu of improving circulation by dredging, such stagnant areas can be supplied with aeration systems (Boozer, 1979) that oxygenate and vertically circulate stagnant water areas. However, this method should remain a rehabilitation technique for existing marinas (Boozer, 1979); new marinas should be designed to maintain adequate DO levels without aeration.

Terrestrial Habitat

Upland facilities constitute an asset that can be as important as the waterfront area and can ultimately determine how successfully the marina operates. In order to support the boating and onshore activities, sufficient land area is required for vehicular parking and vehicular and pedestrian access. Additional land area is required for supplemental service facilities such as an open service yard, open dry boat storage, boat hoist and launching facilities, and fuel facilities. Depending on the marina design, additional land area may be required for items such as swimming pools, tennis and badminton courts, and picnic and playground areas. Upland requirements vary according to the marina concept. In general, however, the land area required to support a marina in a satisfactory fashion will range from less than an acre to an acre and one half per acre of water space in slips and turning areas (Chaney, 1961).

It should be noted that onshore site requirements may differ significantly if the marina utilizes practices such as dry-stack storage, which reduce the water slip areas. Similarly, if the marina is built for a residential development and is intended for the use of the residents (within walking distance), only the required land area for support facilities will be reduced.

Impacts to terrestrial habitats are primarily related to construction of upland facilities and upland disposal of dredged materials. Site clearing and grading will remove the natural protective vegetation which controls erosion. Without that cover, soil is carried into the waterway, causing turbidity. Vegetation should be replaced as quickly as practicable. The soil also contains plant nutrients and other pollutants that can further degrade water quality. Minimizing the damage to natural vegetation is an effective method of controlling erosion, as well as other construction erosion control measures. If marina development requires the unavoidable loss of vegetation considered to be ecologically important, an area of greater value can be restored elsewhere in the ecosystem.

Wetlands and Protected Species

Wetlands function as sediment traps and filters for pollutants. Any activity that reduces the effectiveness of this function can affect turbidity and water quality of adjacent waters. Wetlands also serve as nursery areas and are highly productive, providing a significant source of nutrients to the estuary. Wetlands are therefore vital to the health of the estuarine ecosystem. Any loss of wetlands is generally considered unacceptable by regulatory agencies. When there is no alternative to unavoidable loss of wetlands during marina construction, acceptable mitigation maybe the creation of new wetlands or the restoration of a greater area of previously disturbed wetland. Measures that may be taken to mitigate impacts to wetlands are:

- Avoid dredging through use of existing channels
- Avoid dredging deep channels into wetlands or straightening tidal creeks to obtain access to the marina site
- The construction of access ways through wetlands should be elevated or otherwise permit unrestricted water flow through the wetland
- Wherever possible the marshland should be retained along the shoreline and bulkheads and revetments should be placed along the existing shoreline as close to the upland as possible.

The impact of erosion on inshore or channel shorelines from boat wakes can be prevented or reduced by posting and enforcing "NO WAKE" zones in areas of high boating activity. Since boats approaching a speed-control zone reach their maximum wake speed as they slow down, placing the speed limit signs at locations where the boat is more than 200 feet from shore allows for dissipation of wake energy before reaching the shore (Zabawa and Ostrom, 1980). Not all situations or areas where wakes may be a problem can be patrolled. In these cases, it is often

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simple courtesy on the part of the boater and an individual awareness of potential dangers that limit wake impact. Organizations such as the U.S. Power Squadrons and the U.S. Coast Guard Auxiliary have been instrumental in providing safety awareness to boaters. Public education should be considered high priority for mitigating many types of boating-related impact.

Planting marsh vegetation on stabilized exposed banks can be an efficient deterrent to erosion caused by boat wakes. The establishment of mangroves in conjunction with Spartina is another means of rapid shoreline stabilization for protection against erosion in some locations (Teas, 1980). Mangroves that are sensitive to boat wakes and floating trash can be protected by small breakwaters such as floating tires.

Poorly marked channels in shallow areas may inadvertantly lead to resuspension of sediments by turbulence from boat propellers or to direct contact of organisms by propellers. Because boaters generally prefer to avoid the problems of manuvering in shallow water (Chmura and Ross, 1978), well-marked channels from the marina basin or launch area to deep water would limit this type of impact considerably. Channels two to three feet deeper than the propeller of the deepest draft boat using the area during low water periods generally will be sufficient to prevent greater than normal turbidity (Lagler et al., 1950).

Fauna and flora also can be protected through public awareness. For example, a massive effort by the state of Florida, the U.S. Fish and Wildlife Service and private organizations is underway to educate the public to protect the manatee (Van Meter, 1982). Regulation of boat speeds and limited access in manatee sanctuaries is also underway to reduce boat-related incidents. Similar measures can be taken for other species of concern. Damage to coral heads can be avoided with reasonable precaution when anchoring, since waters where coral heads occur are noted for their clarity and coral heads can be seen from the surface.

The visible presence of humans may disturb wildlife, particularly during nesting seasons. Thus, regulations regarding minimum distances from nesting areas may be set and enforced to reduce noise and other disturbances from passing boats. Minimum distances required to prevent disturbance of nesting birds will vary with the number and species of birds and with the physical characteristics of the site such as the amount of vegetative cover. For herring gull colonies on bluffs above Lake Superior, it was suggested by Harris and Matteson (1975) that people be restricted from approaching within 100 yards during the breeding season. This minimum distance could serve as a guideline for nesting colonies in the southeastern United States, at least until site-specific and/or species-specific studies conclude otherwise. Whatever distance is established, signs on pilings or floats may be positioned to warn boaters of important nesting areas.

On a national and international scale, mitigative measures for plastic pollutants include the manufacture of biodegradable plastics, filtering the outflow of plastic particles from certain industrial operations and plastic recycling. On the state and local level, a first mitigative measure would be to alert the public to the seriousness of plastic pollutants in the marine ecosystem. Both commercial fishermen and recreational boaters may discard plastic and other refuse. Plastics can be properly discarded when easily accessible, well-marked trash disposal facilties are provided at boat ramps and docking areas. Receptacles should be covered to prevent animals such as birds or raccoons from becoming entangled in plastic debris. Similarly, receptacles should be regularly emptied to prevent overflow and the additional possibility of animal entanglement.

Impacts to protected species such as sea turtles and manatees should be avoided. The presence of rare, threatened, endangered or otherwise designated unique species or habitat should be identified early in the marina planning process and planning and design steps taken to avoid any impacts.

Marina sites located near rookery areas or other wildlife refuges or sanctuaries should be buffered through the use of vegetation. Construction activities should be scheduled to not interfere with breeding, nesting or spawning seasons.

Shellfish

The principal factors that promote the propagation, growth, and general welfare of an oyster community are the character of the bottom, water movement, water salinity, temperature and food availability. Unfavorable factors that tend to destroy or inhibit growth and productivity of oyster communities are sedimentation, competition, pollution, disease and predation (Galtsoff, 1964). Marina construction in or adjacent to oyster beds may contribute directly and indirectly to these factors. Bacteriological contamination of shellfish waters can preclude shellfish harvesting for human consumption. Marina construction and operation does not favor oyster production. All available information points to the conclusion that shellfish harvesting from waters near marinas is not desirable from a public health perspective.

A recent survey (USFDA, 1980) of state shellfish sanitation agencies was conducted to determine if states had policies specifically related to marinas (Table 5-7). The majority of states assessed marina impacts on a case by case basis, and most used the USFDA "Approved Area" criterion to some extent. South Carolina and Mississippi currently employ a predetermined radius of shellfish ground closure around a marina 305 meters (1000 feet). The closure of shellfishing grounds around existing marinas conforms to recommendations made by USFDA (1972) and is justified from a public health standpoint. Such closures may not be necessary if shellfish beds are considered prior to marina construction. Maryland has devised a plan to avoid this conflict whereby marina facilities in

TABLE 5-7

RESPONSE TO U.S. FOOD AND DRUG ADMINISTRATION QUESTIONNAIRE REGARDING STATE POLICY ON MARINAS AND CLOSURE OF SHELLFISH AREAS[a]

Inquiry	North Carolina	South Carolina	Georgia	Florida	Alabama	Mississippi
1.Criteria used to determine if closure should be established around a marina	1. Size of marina 2. Number of boats with heads 3. Presence of other identifiable sources of contamination near marina 4. Physical factors relevant to dispersement of pollutants 5. Actual total and fecal coliform levels in water and shellfish near marina	1. Meeting of NSSP "approved area" criteria 2. Size of marina 3. Number of boats with heads 4. Results of monitoring studies	1. Georgia has no marinas in its 4 "approved areas" which are remote from shoreline development. No harvesting is permitted in areas which are developed	1. Presence of live-aboards 2. Does marina have adequate shower and bathroom facilities 3. Presence of pump-out facilities 4. How is sewage disposed of at marina 5. Does marina make boat or other repairs 6. What are provisions for industrial/commercial wastes 7. Size of marina 8. Proximity of shellfish bed to marina 9. Size and general hydrography of adjacent waters	1. Criteria are same as for any other potential source of pollution 2. Presence of live-aboards 3. Meeting of NSSP "approved area" criteria 4. Size of marina 5. Hydrography of adjacent waters	1. Meeting of NSSP "approved area" criteria
2.How is size of closure area determined	No predetermined area. Evaulation of above criteria determines size of closure area	Open shellfish areas should not be located within 1000 feet of marinas; presence of creeks, islands, jetties, etc. that are within 1000 feet radius may make area smaller	NA	No predetermined area. Evaulation of above criteria determines size of closure area.	Goal of 1000 feet around marina dependent on hydrological consideration and the pollutant units	Size determined by a point seaward of where water quality meets NSSP "approved" or "conditionally approved"
3.Point of measurement of closed area	NA	Measured from center of marina	NA	Measured from periphery of marina	Measured from periphery of marina	NA
3.Written policy on marinas	None	None, but written policy of S.C. Coastal Council closely parallels that of DHEC	None	None	None	None

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[a]Olmstead, 1980.

Maryland are restricted within certain distances of viable shellfish beds, based upon the survival time of coliform bacteria and the size of the marina. Marinas with less than 50 boats may be located within 200 meters (1/8 mile) of shellfish beds, marinas with 51 to 100 boats must be a minimum of 400 meters (1/4 mile) from shellfish beds, and marinas with more than 100 boats are restricted to at least 800 meters (1/2 mile) from beds (Ervin et al., 1980). This plan may be used as a guideline for establishing specific state standards depending on coliform bacteria rates. The size of a buffer zone area could be determined through analysis of data from a comprehensive study of biological and hydrological conditions of a proposed marina location and the sanitary and engineering considerations of the marina's design. Shellfish harvesting seasons also may be a consideration when planning construction schedules (Table 5-8).

It is also possible to purify or depurate shellfish harvested from certain polluted waters. This procedure could become an important mitigative measure for area-wide or regional impacts in the future. Because of the potential applications of depuration technology, an in-depth discussion is presented in Appendix C.

Shellfish are particularly sensitive resources with respect to marina development because of the potential for fecal contamination from marinas and boat discharges. Most coastal states within USEPA Region IV impose buffer zones around marinas located in shellfishing waters. Significant permitting issues may arise from resource-use conflicts and this issue can prevent marina permitting (see Section 6.3.3). The primary mitigative measure for impacts to shellfish would be to avoid development within 1000 feet from harvestable shellfish beds.

The marina developer may choose to conduct hydrographic studies with respect to potential contamination of shellfish in order to predict the area of influence from the marina. These predictive techniques are discussed in Chapter 4.0.

One way to mitigate the potential loss of shellfish areas closed by marina construction is to transplant oyster beds or create new oyster beds using crushed oyster shell as "cultch" material. Such efforts are usually successful when shell or seed oyster plantings are made in areas conducive to oyster growth (Gracy et al., 1978; Little and Quick, 1976).

It is also possible to purify or depurate shellfish harvested from certain polluted waters. This procedure could become an important mitigative measure for area-wide or regional impacts in the future.

TABLE 5-8

SHELLFISH HARVESTING SEASONS IN OPEN GROUNDS FOR USEPA REGION IV STATES

State	Oysters	Clams
North Carolina	1 Sep - 30 Apr[a]	no season
South Carolina	16 Sep - 30 Apr	1 Sep - 30 May
Georgia	16 Aug - 14 May	1 Sep - 31 May
Florida	1 Sep - 31 May[b]	no season
Alabama	no season	no season
Mississippi	1 Oct - 30 Apr[a]	no season

[a] Dates may vary slightly from year to year.

[b] Excludes leased grounds and three areas in Apalachicola Bay which are only open during summer months.

5.4.3 Other Mitigative Measures

Historical/Archaeological Resources

Historical or archaeological resources present at the marina site or discovered during construction that may be impacted by marina development can be identified by contacting the State Historic Preservation Officer. Mitigative measures can include:

- Preservation or restoration of the artifacts
- Photographic documentation
- Survey or excavation by professional historians or archaeologists.

Aesthetic Resources

Aesthetic resources contribute to the attractiveness of the area for development. Measures to protect and maintain water quality, minimize modifications to existing resources and develop the marina facility to be aesthetically compatible with the area will serve to preserve the aesthetic appeal of the location.

Marinas in urban locations may improve waterfront areas through developing attractive facilities. Marinas developed in a rural area should have soft lines and blend into the surroundings.

Public Access

Public access to navigable waters is a concern of permitting agencies when reviewing marina permit applications. Designs that incorporate provisions for public access through providing boat ramps, parks or other public recreational facilities will be a positive factor.

In areas where maintaining public access to recreational waters is increasingly difficult, mitigative measures can include leasing of state submerged land for marina development. The plan recommended by the Florida Blue Ribbon Marina Committee (1983) encourages public access by providing a discount from the base leasing fee when public access is part of the marina operating plan. This concept also has been applied to mitigating potential impacts to specially designated resource protection areas by charging a higher lease fee for developments in these areas. This fee could be conveniently applied to obtain necessary funds for marina-related impact assessment and resource management needs.

Navigation

The principal impact to navigation that can result from marina development is the obstruction of existing traffic on the waterway. Mitigative measures include:

- Providing adequate channel, basin and turning fairway area with sufficient depth for safe navigation (the channel width must permit boats to pass in opposite directions at the same time)
- Position equipment during construction so as not to interfere with boating traffic on the waterway
- Protective and mooring structures should be placed in a manner which allows adequate room for navigation in the adjacent waterway
- Channels should be clearly marked.

The size of turning areas and fairways within the marina basin must balance the construction costs of an expanded water area with potential boat handling difficulties from too little water area for safe maneuvering. The recommended width for a fairway between rows of slips in quiescent waters should be 1.25 to 1.5 times the length of the longest slip (Chamberlain, 1983). In general, an accepted width of water area for turning, entering, and leaving slips is 2.25 times the length of the longest boat (Chaney, 1961). Both of these design considerations are subject to minor modifications, depending on boat length and type (single vs. twin screw, etc.), current, and obstructions encountered at the marinas.

The transition from open water to the marina should be smooth. The entrance channel should be as straight as possible and follow an existing natural channel where practicable to minimize dredging. Access channels that are three to four times the width of the largest boat to use the marina facility are adequate (U.S. Department of Commerce, 1976).

5.5 Marina Operation and Maintenance

A coastal marina designed and constructed using the most environmentally sound methods can be ineffective without proper operation and maintenance. A clear and complete operations and maintenance plan should be available at all times. The dockmaster and marina attendants should be completely familiar with the specified standard operating procedures. It may be helpful for marina operators to receive training and certification from suppliers and equipment manufacturers on proper operation and maintenance of boats and other specialized marina equipment. The specification of performance standards for marinas could be an effective management tool for controlling pollutants.

Routine marina upkeep should include the regular collection of all litter in covered containers, the regular maintenance of fuel pumps and spill prevention measures to prevent spills, and the removal of debris that accumulates on the shore.

5.5.1 Water Quality Considerations

Dredging

Maintenance dredging may be necessary in some marinas. During marina planning, provisions should have been made to dispose of any dredged material in upland areas away from the marina. Most maintenance dredging involves spot dredging of silt fines or sands. Suction head dredges have been used for this work around marina structures to prevent damage that dragline and clamshell dredges may cause. A suction head dredge uses high-pressure water jets to loosen bottom material and compressed air to operate pneumatic slurry pumps to force material in concentration through a discharge line (Dunham and Finn, 1974).

Runoff

Maintaining water quality within the marina basin requires effective management and use of the stormwater management plan. Careful attention to boat maintenance and repair activities is essential. Mitigative measures that can be employed during marina operation include:

- Require that paint spraying, sand blasting, engine repairs, boat washing and similar maintenance activities be performed on shore either indoors or behind canvas screens. These activities should not take place near ramps, on railways or in the harbor where pollutants can readily wash or fall into marina waters

- Use of non-phosphate detergents can greatly reduce the amount of nutrients entering marina waters.

Boat Wastes

Properly maintained and convenient waste disposal services, including garbage disposal and onboard wastewater collection, are important to the boat owner who has no other means of proper disposal. The disposal services should be capable of handling heavy weekend or seasonal usage. Trash containers should be convenient and secure to prevent litter from falling or blowing into the water. With regard to boat holding tank wastes, marina experience has shown that collection facilities should be conveniently available at existing fueling stations. Facilities for pumping out larger boats that remain in their slips and for handling wastes from small portable toilets also should be provided as required. Another method of handling boat wastes is to provide convenient shoreside restroom facilities of adequate size with hot showers and wash basins. Restrooms, if well maintained, will tend to reduce boat toilet use (Chmura and Ross, 1978).

Oily wastes can enter marina waters from the discharge of bilge water. This type of pollution can be reduced or eliminated through strict marina rules and management. Boats can be fitted with oil filtering devices and contain oil-absorbent pads in their bilges. Control of pollutants from bilge water also can be implemented through discharge of bilge water into a slipside vacuum system such as the commercially available ENVIROVAC system described previously. This system can handle wastewater at rates up to 18 gallons per minute.

Potential sanitary waste discharge into marina waters can be mitigated by:

- Posting and strict enforcement of discharge rules in the marina
- Requiring all boats with installed MSDs to be connected to a sanitary waste collection system when moored in the marina
- Sealing discharge outlets from Type I and Type II MSDs when boats enter the marina and requiring portable toilets or requiring all boats berthed in the marina to have an approved Type III MSD or a portable toilet
- Banning liveaboards or requiring that these boats be permanently connected to a slipside sanitary waste collection system.

5.5.2 Ecological Considerations

Aquatic Habitat

The mitigative measures for controlling pollutants discharged into marina waters in previous water quality sections are applicable to all ecological habitat resources. Enforcement of speed limits within marinas and adjacent waterways and clearly marked channels also can protect aquatic organisms. Posting of no-wake zones can help prevent damage from boat-generated waves. Clearly marked channels and areas identified by special markers can eliminate or reduce damage to resources such as grassbeds in the vicinity of the marina.

Terrestrial Habitat

Control of boat speeds can help prevent shore erosion due to boating activity. Eroding areas should be immediately stabilized. Groundskeeping is an important maintenance responsibility. The marina grounds should be kept clean and attractive. Good maintenance practices should be extended to the marina waters and shoreline. In addition to the normal groundskeeping duties, the maintenance staff should consider the following:

- Utilizing professional landscaping practices
- Conservative use of insecticides, herbicides and fertilizers
- Clean-up of shoreline and beach debris washed up on shore
- Prevention and clean-up of petroleum spills from upland fueling stations
- Maintaining a regular trash collection schedule.

Wetland and Protected Species

Damage to wetland resources from erosion can be lessened through controlling boat speed in waterways. The mitigative measures for controlling pollutants and maintaining water quality are applicable to protecting wetland resources.

The visible presence of people and associated boating noise can significantly affect wildlife during the breeding season. Public education, specifying safe minimum distances, maintaining vegetative buffers and otherwise controlling access to wildlife nesting and spawning areas during critical periods can solve potential problems.

Marinas located near manatee sanctuaries or turtle nesting areas should ensure that patrons are cognizant of the presence of these organisms during critical periods. Posting rules and regulations in the marina can be an effective means of controlling boating activities.

Shellfish

Posting and enforcement of discharge rules for boats berthed in marinas, particularly sanitary waste discharges, can help to maintain harvestable shellfish waters and state water quality standards for marina waters.

5.5.3 Other Considerations

Marinas in residential areas should maintain a "good neighbor" policy by stipulating and enforcing rules to control noise. Buffers between marina sites and residential areas can be provided and maintained.

A well-managed marina with adequate attention to controlling wastes and litter will be aesthetically pleasing to both patrons and adjacent property owners. Marina personnel should be sufficiently experienced, trained and familiar with marina operation and maintenance plans to:

- Handle administrative requirements and problems
- Properly execute marina services such as boat launching, fueling, boat repairs and sales
- Exercise necessary control over marina activities
- Maintain the premises in good condition.

5.6 Summary

Every marina site presents unique aspects in relation to providing adequate recreational boating facilities at a reasonable cost to the developer while minimizing adverse environmental effects. The engineer and developer must evaluate several planning and design options in determining the most suitable marina development. This evaluation includes considerations of:

- Land and water access
- Access to utilities
- Area requirements for facilities
- Weather and physical environmental conditions
- Environmental protection
- Aesthetics.

The marina should provide maximum natural protection, while minimizing habitat alterations and undesirable environmental changes.

Marina design must accommodate a variety of conditions related to the environment in which marinas must function. The design engineer must be aware of the environmental parameters that will affect the longevity and functioning of the marina and marine structures when planning and evaluating marina design.

The ultimate environmental performance of a marina depends not only on the site location but on the design, construction, operation and maintenance of the facility as well. Proper site planning can help avoid or minimize many of the impacts that can result from marina development. Designing the marina to take maximum advantage of the natural attributes of the site can contribute significantly to reducing or eliminating potential environmental problems from marina construction. During marina operation and maintenance, implementation of a clear and complete operations and maintenance plan can contribute significantly to the environmentally sound performance of the marina facility.

Alternative measures taken during marina design and construction are directed toward avoiding adverse impacts on water quality and aquatic biota such as shellfish and grassbeds, wetland habitats and protected species. Mitigative measures also are employed to minimize unavoidable adverse impacts to water quality and aquatic and terrestrial habitats. Habitat creation and habitat rehabilitation can be acceptable mitigative measures in some cases.

The principal environmental solutions that can be applied during marina operation and maintenance relate to good management and pollution control practices. High quality management of marina operations is essential for the financial success of a marina. Effective management is not only financially desirable, but will help assure that the marina functions in an environmentally sound manner and remains attractive to marina patrons.

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6.0 REGULATION

6.1 Overview

A complex and sometimes confusing variety of federal, state, regional and local regulations concerning coastal development have evolved over the years. These regulations are designed to protect the public interest and conserve coastal resources by reducing development impacts and providing an orderly approach to coastal development. This chapter provides both marina developers and regulatory agency staff with a resource that outlines the objectives, procedures and areas of responsibility for the primary regulators of marina development in USEPA Region IV.

Use of Section 6.2 will provide a general understanding of the main functional roles of agencies involved in coastal marina regulation. Table 6-1 summarizes these agency roles as they relate to various coastal resource impact categories. A Handbook user interested in the role of the U.S. Army Corps of Engineers in marina regulation, for example, would want to concentrate on this section.

More detailed information on the regulatory involvement of each federal and state agency for specific impact categories is presented in Section 6.3. A reader interested in regulation of coastal marinas for the protection of aquatic habitat resources, for instance, can refer directly to Section 6.3.3 which covers this subject.

A description of desirable features of regulatory programs is presented in Section 6.4. In some cases these features are already in use in some regulatory programs; in other cases these are features that would improve marina regulatory programs.

Specific information on coastal marina permitting in USEPA Region IV is presented in Section 6.5. This description is broken down by federal and state agency. For each, the overall permitting process is outlined and, in most cases, illustrated by a flow diagram. Also, for each permitting agency, the bases for decision-making are presented with emphasis on permit evaluation criteria. Examples of actual permit conditions for each state are given. Each state discussion is concluded with a summary of the permitting procedure and an approximate timetable for each stage of the process.

A comparison of the state programs follows the individual state discussion. The roles of local agencies in marina regulation are discussed and some innovative marina ordinances summarized.

Supporting Appendices for this chapter provide information on whom to contact concerning permit applications (Appendix F), sample permit application forms and information (Appendix G), and some examples of local ordinances regulating marina activities (Appendix D).

A Handbook user interested in obtaining permits for a marina development in South Carolina, for example, would want to read (in addition to other pertinent Sections of this Chapter) the description of the federal permitting process in Section 6.5 and then go to the South Carolina program discussion. Reference to the permit application materials in Appendix G for South Carolina would introduce the reader to some of the specific required information regarding a permit application. Using the information in Appendix F, the appropriate federal and state permitting agencies should then be contacted for the most current permit application information and materials.

This chapter was organized as a resource that does not have to be read in its entirety. Thus, some important information has been repeated in some of the Sections to eliminate cumbersome cross-referencing and to ensure its attention by the reader. The information in this chapter will provide the Handbook user with a sound basis for pursuing marina regulatory matters.

6.2 Agency Functional Roles in Regulation

The primary functional roles of each agency involved with marina regulation are shown on Table 6-1. The regulatory functions that each agency carries out are listed by coastal resource. These functional roles are:

Resource Management (RM) - Indicates that the agency is responsible for long-term planning to manage or protect the particular resource. The agency is not limited to specific case-by-case decision-making with respect to the resource.

Permitting (P) - Denotes that the agency has permitting authority over marina development for the particular resource category.

Water Quality Certification (W) - Indicates that the agency issues the Section 401 water quality certification for water resources.

Monitoring (M) - Indicates that the agency carries out monitoring activities to assess performance of the permitted activities with respect to permit conditions.

Compliance (C) - Signifies that the agency has the means and authority to enforce regulations and permit conditions.

State Land Lease (P*) - Indicates that the agency issues state land leases for the use of submerged lands.

Table 6-1 shows that permitting authority (P) only appears under a few resource categories for most agencies. This is because the definition of functional roles was strictly applied. A "P" only appears under those resource categories that were specifically intended by state or federal authorizing legislation to be the primary focus of the agency's

TABLE 6-1

FUNCTIONAL ROLES OF PERMITTING AGENCIES

Agency	Major Impact Categories							
	Water Quality Resources	Groundwater Resources	Aquatic Habitat Resources	Terrestrial Habitat Resources	Wetland Resources	Socio-Economic Resources	Navigation Resources	Aesthetic Resources
U.S. Environmental Protection Agency (USEPA)	RM,P,M,C	-	-	-	-	-	-	-
U.S. Army Corps of Engineers (USACOE)	P,M.C	P,M,C	P,M,C	-	P,M,C	P,M,C	P,M,C	-
U.S. Coast Guard (USCG)	M,C	-	-	-	-	-	M,C	-
North Carolina Department of Natural Resources and Community Development, Office of Coastal Management (NCDNRCD/OCM)	-	RM,P,M,C,	RM,P,M,C	RM,P,M,C	RM,P,M,C	-	-	RM,P
North Carolina Division of Environmental Management (NCDNRCD/DEM)	RM,W,M,C	P,M,C	-	-	-	-	-	-
South Carolina Coastal Council (SCCC)	-	-	RM,P,M,C	RM	RM,P,M,C	RM	-	-
South Carolina Department of Health and Environmental Control (SCDHEC)	RM,W,M,C	W,M,C	-	-	-	-	-	-
Georgia Department of Natural Resources, Coastal Resources Division, Coastal Marshlands Protection Committee, (GDNR,CRD/CMPC)	-	-	P,M,C	-	P,M,C	-	-	-
Georgia Department of Natural Resources, Environmental Protection Division (GDNR/EPD)	RM,W,M,C	P,M,C	-	-	-	-	-	-
Georgia Department of Natural Resources (GDNR)	-	-	-	-	-	P*	-	-
Florida Department of Environmental Regulation (FDER)	RM,W,M,C	P,M,C	P,M,C	-	P,M,C	-	-	-
Florida Department of Community Affairs (FDCA)	-	-	-	-	-	RM,P	-	-
Florida Department of Natural Resources (FDNR)	-	-	-	-	-	P*	-	-
Alabama Department of Environmental Management (ADEM)	RM,W,M,C	P,M,C	P,M,C	-	P,M,C	-	-	-
Alabama Department of Conservation and Natural Resources (ADCNR)	-	-	P	-	P	P*	-	-
Alabama State Docks Department (ASDD)	-	-	-	-	-	-	P,M,C	
Mississippi Bureau of Marine Resources (MBMR)	-	-	RM,P,M,C	RM,P,M,C	RM,P,M,C	RM	-	-
Mississippi Bureau of Pollution Control (MBPC)	RM,W,M,C	P,M,C	-	-	-	-	-	-
Mississippi Secretary of State (MSOS)	-	-	-	-	-	P*	-	-

PLANNING/RESOURCE MANAGEMENT - RM
STATE LAND LEASE - P*
PERMITTING - P
MONITORING - M
COMPLIANCE - C
WATER QUALITY CERTIFICATION - W

TABLE6-1;COASTALXII

regulatory program. Therefore, a "P" is shown under aesthetic resources for only one state agency. Although most regulatory programs allow for appropriate consideration of all resources listed in Table 6-1 and consider aesthetic impact to some extent in their decision-making process, the primary focus for most programs is generally water quality, aquatic habitat and wetland resources.

Resource Management (RM) only appears for a few state agencies and resource categories. This is because most of these agencies regulate marina development through a case-by-case permit review procedure and do not exercise long-term planning roles for management and protection of all listed resources. Exceptions are Mississippi and to some extent North and South Carolina, where state coastal zone management agencies can designate critical areas, areas of environmental concern, or special management areas, independent of and prior to a decision on a marina permit in a specific area, thereby exercising resource management functions.

Few of the agencies in Table 6-1 exercise specific functional roles with respect to terrestrial habitat, socioeconomic and aesthetic resources. Permitting authority (P) with respect to these resources is shown for three state agencies, North Carolina DNRCD/OCM, Florida DCA and Mississippi BMR. The Florida Department of Community Affairs (FDCA) is not directly involved in marina siting but has a permitting role with respect to socioeconomic resources for some larger marinas (100 or more slips) based on the state's Development of Regional Impact (DRI) program. Four state agencies also administer state land leases, indicated by P* under socioeconomic resources in Table 6-1.

The general lack of direct functional involvement of permitting agencies with respect to terrestrial, socioeconomic and aesthetic resources illustrates that regulatory authority for marina permitting is focused on aquatic, wetland and water resources. Potential impacts on landside resources are considered in the decision-making process; however, impacts to these resources are not the primary concern of the regulatory agency. Identification and evaluation of impacts is often the responsibility of a separate review agency.

6.2.1 Federal Agencies

The U.S. Army Corps of Engineers (USACOE) is the federal agency with direct permitting authority for coastal marinas, although USEPA participates with the Corps in implementing this authority. Permitting authority is vested in the USACOE under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. Guidelines which the USACOE applies in evaluating disposal sites for dredged or fill material under Section 404 are developed by USEPA. The expressed goal of the 404 program is to protect water quality, aquatic resources and wetlands, but the evaluation guidelines developed by USEPA also state that no discharge will be permitted if it will result in significant adverse impacts on other factors, including municipal water supplies, recreation, economic and aesthetic values. For this reason a functional permitting role (P) is recognized for the USACOE in most of the resource categories.

Although USEPA, jointly with USACOE, develops evaluation criteria for disposal of dredge and fill material under Section 404, they are not the permitting agency. The USEPA does not typically exercise any direct permitting control over marina development. However, under 404(c) USEPA has ultimate authority to veto dredge and fill permits.

The functional roles for USEPA under the water quality and groundwater resource categories reflect the agency's authority to set water quality standards and permit the discharge of pollutants. The NPDES permitting authority has been delegated to all USEPA Region IV coastal states except Florida.

The U.S. Coast Guard (USCG) has authority to enforce regulations controlling marine sanitation devices (MSDs) and aids to navigation. MSD regulations do not directly affect marina developments, but since the USCG regulations now require most boats to have holding tanks, many states require marinas to provide pumpout facilities.

A marina developer is also responsible for arranging with either the Coast Guard or approved state agency to provide private aids to navigation from the marina to the nearest channel. The USCG has established standards for navigation aids and has authority to install necessary aids when a developer has not installed appropriate navigation aids.

6.2.2 State Agencies

State marina permitting programs vary within USEPA Region IV. Some states issue separate dredge and fill, marshland or wetlands permits for marina developments, while other states review federal permit applications and do not issue state permits. All coastal states have the authority to veto Section 10/Section 404 permits if the proposed action is inconsistent with the state's Coastal Zone Management program, except Georgia, which did not elect to participate in the CZM program under the Coastal Zone Management Act. All states have authority under the Clean Water Act to issue Section 401 water quality certifications for federal permitting actions as part of their water quality standards program.

The Clean Water Act requires that states adopt water quality standards in order to protect public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. A water quality standard defines the water quality goals for a particular water body, by indicating its use and by setting criteria necessary to protect that use. The water quality standards program through the antidegradation policy requires that existing uses be maintained. Existing uses are those uses actually being attained. Existing uses are determined by the states who have responsibility for identifying uses and when they are actually attained. A more detailed discussion of the antidegradation policy is found in Section 6.3.3 under "Marinas, Shellfish Harvesting and Antidegradation."

The water quality standards program is designed to protect designated and existing uses. In marina permitting actions (Section 404 and certain Section 10 permits), states are asked to certify that marina projects will not violate established criteria or preclude existing uses of the area's waters. This certification is required for a permit to be issued. Denial of certification results in denial of a federal permit.

North Carolina

There are two state agencies in North Carolina with regulatory authority for marinas. The North Carolina Office of Coastal Management (NCOCM) is the state's coastal management agency. Because NCOCM designates areas of environmental concern (AECs), the agency has resource management (RM) planning authority for the resource categories indicated in Table 6-1. This agency also has permitting, monitoring and compliance authority for both the Coastal Area Management Act (CAMA) program and the general permit program delegated to the state by the USACOE.

The North Carolina Department of Natural Resources and Community Development, Division of Environmental Management (NCDEM) has authority to issue water quality certifications under Section 401 of the Clean Water Act.

South Carolina

South Carolina has the same type of functional organization as North Carolina. The South Carolina Coastal Council (SCCC) is the agency with responsibility for coastal zone management. SCCC carries out resource management functions for the resource categories indicated on Table 6-1 by virtue of its authority to designate critical areas. The Coastal Council also issues permits for construction in tidal waters and has monitoring and enforcement authority.

The South Carolina Department of Health and Environmental Control (SCDHEC) is the state agency which is responsibile for issuing 401 water quality certifications and for follow-up monitoring and enforcement. In carrying out this responsibility SCDHEC also exercises certification authority for groundwater as well as surface water.

Georgia

There are two state agencies directly involved with marina regulation in Georgia. The Georgia Coastal Marshland Protection Committee (GCMPC) has authority to issue permits for any activity that would require dredging, draining, filling or any other alteration of coastal marshlands.

Other direct authority in the state rests with the Georgia Department of Natural Resources, Environmental Protection Division (GEPD). This agency issues the 401 water quality certification. GEPD also has authority to monitor activities covered by the 401 certification and to require compliance with any conditions. Additional functional roles designated for GEPD reflect the agency's authority to set water quality standards and designate use classifications for waters of the state.

Florida

Agencies in the state of Florida have regulatory authority under more resource categories than agencies in most of the other states. This is in part because of the number of different state programs and agencies that may be involved with marina development. The Florida Department of Environmental Regulation (FDER) has authority to issue water quality certifications and to approve dredge and fill permits under two separate statutes. Florida is also one of the few states which has direct permitting authority over marinas with respect to their impact on socioeconomic resources. This authority is carried out by the Florida Department of Community Affairs (FDCA) under the Development of Regional Impact (DRI) program. The Florida Department of Natural Resources (FDNR) also has authority to grant a lease for state-owned bottom land. FDNR also grants coastal construction and coastal construction control line permits under the state's coastal zone management program. The coastal construction control line permit is necessary only in beach front areas and, therefore, is almost never required for marinas.

Alabama

The Alabama Department of Environmental Management (ADEM), through its coastal management and water quality review, is the primary state agency having responsibility for marina development. It is significant to note, however, that although ADEM exercises review and approval of USACOE permits, this agency does not administer a separate permit program for dredge and fill and wetland related projects. ADEM also carries out the 401 water quality certification.

The Alabama Department of Conservation and Natural Resources (ADCNR) also has a regulatory role in marina development in Alabama. ADCNR approves state land leases and administers a permit program controlling dredging of state owned submerged lands (authority up to mean high tide line).

A third state agency, the Alabama State Docks Department (ASDD) also can control marina development through its authority to issue permits for construction of structures in water on navigable streams.

Mississippi

There are three state agencies in Mississippi with functional roles in marina development. The Mississippi Bureau of Marine Resources (MBMR) is the state's primary coastal management agency. It administers the state's coastal zone management plan and Coastal Wetlands Protection law. Under these authorities it exercises a resource management function with respect to many of the major impact categories (see Table 6-1). Under the Wetlands Act, MBMR also issues permits for dredging, filling or erection of structures in coastal wetlands.

The Mississippi Bureau of Pollution Control (MBPC) has authority to establish water quality standards, designate stream classifications, and issue 401 certifications.

The Mississippi Secretary of State (MSOS) issues submerged land leases.

6.2.3 Review Agencies

In addition to those agencies with direct permitting or certification authority over marina development, there are numerous federal and state agencies which review permit applications and provide comments on the potential impacts of marina developments.

Federal

At the federal level the principal review agencies are the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS). Under the Fish and Wildlife Coordination Act both have authority to consider and comment on impacts to wildlife and marine resources resulting from water resources development. The USFWS also reviews potential impacts to endangered species under the Endangered Species Act of 1973. If USFWS determines that an activity may jeopardize the existence of an endangered species or destroy or modify habitat critical to the existence of a species on the threatened or endangered list, then the Corps may not issue a Section 10/404 permit for the activity without further consideration.

State

In each state there are significant numbers of state agencies to which USACOE or state dredge and fill permits are sent for review and comment. The agencies most typically involved are those with authorities over water resources (when the agency is not already performing a direct permitting function), wildlife, land use, transportation, public utilities, and historic preservation. In most cases the comments from these agencies do not ultimately control the permit decision. However, the permitting agencies consider all comments and can deny the permit when comments indicate the potential for significant impact to a given resource.

In the case of historic and archaeological resources, a finding of significant impact can cause a USACOE permit under Section 404 to be denied. Under Section 106 of the National Historic Preservation Act, the USACOE must ascertain if properties potentially affected by a marina development are listed on or eligible for inclusion in the "National Register of Historic Places". The USACOE must then consider the effect of marina development on these historic properties. The state historic preservation officer (SHPO) has the responsibility under Section 106 regulations to assist in the identification of "National Register" properties and to determine possible adverse impacts. Typically, when adverse impacts are likely, mitigation measures may be agreed to through a Memorandum of Agreement (MOA). If an MOA is not reached, the USACOE may deny the permit, although denial is not mandatory.

6.3 Regulatory/Planning Responsibilities for Specific Coastal Resource Impact Categories

6.3.1 Water Quality Resources

Agencies with functional roles relating to water quality resources include USEPA, USACOE, USCG and State water agencies.

The USACOE carries out permitting, monitoring and compliance activities under authority of the Clean Water Act and River and Harbor Act of 1899. The USACOE does not exercise any planning function with respect to water quality.

The USEPA has permitting, monitoring, compliance, and resource management (planning) responsibilities based on authorities in numerous sections of the Clean Water Act. Specifically, USEPA sets guidelines for establishing water quality standards (USEPA can also directly establish these standards), monitoring water quality, approving discharge permits and certifying compliance with water quality standards for federally permitted activities, requiring compliance with permit limitations, sets standards for MSDs, and establishes criteria for ocean discharges. Many of these responsibilities can and have been delegated to the states. USEPA also assists the USACOE in administering the dredge and fill permit program.

The USCG does not exercise permitting functions related to water quality resources. USCG does, however, have authority to monitor and enforce compliance with MSD regulations.

At the state level, state water quality agencies carry out a number of functions affecting marina development. Within Region IV these agencies include:

- North Carolina Department of Natural Resources and Community Development, Office of Coastal Management
- South Carolina Department of Health and Environmental Control
- Georgia Department of Natural Resources, Environmental Protection Division

- Florida Department of Environmental Regulation
- Alabama Department of Environmental Management, Water Improvement Commission
- Mississippi Bureau of Pollution Control.

Generally, these agencies set water quality standards, designate water quality classifications for specific water bodies, issue discharge permits, issue 401 certifications and carry out monitoring and compliance activities related to these planning and permitting functions.

6.3.2 Groundwater Resources

The USACOE and state water resource agencies have functional roles relating to groundwater resources.

The USACOE carries out permitting, monitoring and compliance activities under 40 CFR Part 230, "Guidelines for Specification of Disposal Sites for Dredged or Fill Material". The USACOE does not exercise any planning function with respect to groundwater quality.

Impacts to groundwater are not normally a key consideration in the state's permitting process. In most states, if marina construction or operation presents potential impacts to groundwater, these impacts are evaluated by respective water resource agencies in conjunction with the 401 certification process. These agencies are:

- North Carolina Department of Natural Resources and Community Development, Office of Coastal Management
- South Carolina Department of Health and Environmental Control
- Georgia Department of Natural Resources, Environmental Protection Division
- Florida Department of Environmental Regulation
- Alabama Department of Environmental Management, Water Improvement Commission
- Mississippi Bureau of Pollution Control.

Each agency carries out permitting, monitoring and compliance functions as appropriate with respect to groundwater resources.

The SCDHEC routinely considers impacts to groundwater as part of the 401 certification process. The ADEM is responsible for managing any use which might contribute to a waste discharge from a point or non-point source to groundwaters of the Coastal Area. MBPC carries out functional roles only if the project will impact a known wetlands recharge area or a shallow aquifer area. In North Carolina, Georgia and Florida, if impacts to groundwater are suspected, then functional roles will be exercised. In addition, NCDNRCD/OCM carries out planning functions if a project is sited in a well field area, an area considered a "critical environmental area" by the state.

6.3.3 Aquatic Habitat Resources

Aquatic habitat resources are one of the key areas of concern for federal and state dredge and fill programs. As such, many agencies are involved in several functional roles with respect to aquatic habitat resources.

USEPA does not have a direct functional role with respect to aquatic resources; however, the guidelines used by USACOE in evaluating dredge and fill permits were developed jointly by USEPA and USACOE (see 40 CFR 230, particularly subparts C, D, and E which address impacts to various aquatic habitat resources).

The USACOE has a significant direct functional role with regard to aquatic habitat resources. The USACOE 404 permit program focuses on aquatic habitat and wetland resource impacts. Any permit for a marina development which poses significant adverse impacts for aquatic habitat resources may be denied or appropriately modified as a result of the USACOE permit evaluation.

Each coastal state within USEPA Region IV also carries out a variety of insititutional responsibilities directly related to aquatic habitat impacts. The state agencies involved are typically coastal management agencies. These include:

- North Carolina Department of Natural Resources and Community Development, Office of Coastal Management
- South Carolina Coastal Council
- Georgia Department of Natural Resources, Coastal Resources Division, Coastal Marshlands Protection Committee
- Florida Department of Environmental Regulation
- Alabama Department of Environmental Management
- Mississippi Bureau of Marine Resources.

Although Florida DER is not the lead state agency for coastal zone management, it administers both water quality and state dredge and fill programs.

Typically, state authority with respect to issues affecting aquatic resources is exercised through a dredge and fill permit program. In most states the program is carried out jointly with the USACOE 404 permit program. Alabama does not have a separate state permit program, but approves the USACOE permit. In some states, this regulatory authority is combined with or augmented by a coastal critical areas type of permit. Regardless of the exact arrangement, each state carries out a permitting role. Each state also monitors compliance with permit conditions and has some procedures for ensuring compliance.

Shellfish Resources

Significant permitting issues may arise from potential impacts to shellfish resources. These impacts are considered as part of the Section 10/Section 404 permit review process and in state permitting programs. Where marinas are proposed in waters that are currently used for shellfish harvesting, bacterial and/or other contamination can become a significant issue. Most USEPA Region IV coastal states prohibit shellfishing within specified distances from marinas. The majority of state shellfish sanitation agencies establish these buffer zones on a case-by-case basis.

The state agencies primarily concerned with shellfish resources are:

- North Carolina Department of Human Resources, Division of Health Services, Shellfish Sanitation Office
- South Carolina Department of Health and Environmental Control, Shellfish and Recreational Waters Division, Bureau of Special Environmental Programs
- Georgia Department of Natural Resources, Coastal Resources Division
- Florida Department of Natural Resources, Division of Marine Resources and Division of State Lands
- Alabama Department of Conservation and Natural Resources
- Mississippi Bureau of Marine Resources, Wetlands Division and Mississippi Department of Health, Shellfish Sanitation Office.

Marinas, Shellfish Harvesting and Antidegradation

Water quality standards regulations require states to develop and adopt a statewide antidegradation policy. It is the purpose of this policy to assure that existing instream uses and the level of water quality necessary to protect those uses are maintained and protected. An "existing use" can be established by demonstrating that fishing, swimming or other uses have actually occurred since 28 November 1975, or that the water quality is suitable to allow the use to be attained (unless there are physical problems, such as substrate or flow, which prevent the use regardless of water quality.

The Clean Water Act (CWA) requires that states provide for the protection and propagation of fish, shellfish and wildlife and provide for recreation in and on the waters of the United States. Beyond these CWA requirements, water quality standards regulations charge states with assuring compliance with antidegradation requirements. States must determine what are the existing uses of their waters and the level of water quality necessary for their protection.

Shellfish harvesting is a use that is covered by the antidegradation regulations. For example, consider a situation where shellfish are apparently propagating and surviving in a biologically suitable habitat and are suitable for harvesting. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality.

Section 101(a)(2) of the Clean Water Act calls for that level of water quality which "...provides for the protection and propagation of fish, shellfish, ..." To say that the shellfish use exists, and that the water quality must be maintained, only if the shellfish are literally being "harvested" undercuts the objective of the Act to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

State water quality agencies should consult with the state agency responsible for shellfish harvesting to determine if potential or actual uses are known and documented. States should use the public notice and public hearing processes to determine if shellfish harvesting uses exist that have not otherwise been identified. The process used to make each determination should be documented.

When considering a loss of an existing use, a decisionmaker should address the specific area where existing uses may be affected. The presence of existing uses in adjacent unaffected areas, no matter how small or large, does not materially affect decisions regarding the specific waters where existing uses may be affected.

The level of water quality is important in regards to antidegradation policy. If loss of a use (establishment of a buffer zone where shellfish harvesting is closed) is based on a recognition that water quality is likely to be lowered to the point that it no longer is sufficient to protect and maintain an existing shellfish harvesting use and the public health, allowance of such loss of use is inconsistent with EPA's antidegradation regulations. Wherever actions affect the probability of lower water quality and this change in probability precludes an existing use, this action should be considered to affect the level of water quality and would be inconsistent with antidegradation requirements.

In summary, it is necessary for states to fully consider the antidegradation policy in specific decision-making related to marinas in shellfishing waters. Deliberate and documented decisions should be made. Opportunity for public comment and discussion should be given. And finally, the intent of the antidegradation policy should be followed. Appendix E presents copies of letters and memoranda relating to marinas, shellfish and antidegradation.

6.3.4 Terrestrial Habitat Resources

Impacts to terrestrial habitat resources are considered by the USACOE and by state agencies which administer either dredge and fill or coastal areas permits. These state agencies include:

- North Carolina Department of Natural Resources and Community Development, Office of Coastal Management
- South Carolina Coastal Council
- Georgia Department of Natural Resources, Coastal Resources Division, Coastal Marshlands Protection Committee
- Florida Department of Environmental Regulation
- Alabama Department of Conservation and Natural Resources
- Mississippi Bureau of Marine Resources.

Although all regulatory programs consider terrestrial resource impacts, state and federal permit programs generally are not focused on terrestrial impacts and few programs are directed toward equal consideration for terrestrial and aquatic resource impacts. Terrestrial resource impacts are typically addressed through comments from review agencies and are not necessarily a deciding factor in permit approval. However, comments from the USFWS, which functions as a federal review agency for USACOE 404 permits, may result in permit denial if an endangered terrestrial species may be affected.

Two state regulatory programs are broader in scope than the dredge and fill programs in other states and provide for direct consideration for terrestrial resource impacts. These are the North Carolina CAMA permit and Mississippi Coastal Wetlands permit programs administered by NCDNRCD/OCM and MBMR, respectively. The broader scope of state coastal area programs in North Carolina, South Carolina and Mississippi also provide for resource management functions carried out by NCDNRCD/OCM, SCCC and MBMR, with respect to terrestrial resources.

Water Quality Certification in Coastal Waters

Shellfish resources are an important consideration in the water quality certification process for coastal marinas. Simply stated, if a shellfish resource is present and the water quality is suitable for shellfish harvesting, a proposed marina development that would cause loss of the use of this resource would be inconsistent with the antidegradation requirements of the water quality standards regulations.

Figure 6A diagrams the progression of decisions (square boxes) and actions (rounded boxes) relating to marina siting in coastal waters. The figure takes into account recent interpretations by the EPA Office of Water of "existing uses" related to antidegradation.

There are two determinations that must be made to complete the water quality certification process. Water quality standards criteria must be met and there must be compliance with the state's policy on antidegradation. The major controlling determination for coastal marinas is the antidegradation requirement.

The certification process begins with a determination of the state water quality use designation for the waters at the proposed marina site. Such information is available from the state water quality agency. For waters classified for shellfish harvesting use, it is necessary to determine if water quality criteria will be met during construction and following completion of the project. A particularly important water quality criteria for shellfish harvesting waters is the fecal coliform requirement. The determination of compliance with such criteria typically assumes pollution control devices are operating properly.

If the state determines that water quality criteria will be met, the state's antidegradation policy must be considered. The antidegradation policy requires that existing uses be maintained. Existing use has been defined as where a use has been documented since November 28, 1975 or where the water quality at the site is suitable to allow the use to be attained and no physical problems exist to preclude its attainment.

The state shellfish harvesting agencies are a primary source of information related to whether shellfish harvesting has occurred at the site since 1975. This source can be supplemented by information from the state coastal zone management agency, local shellfishermen or field survey data.

If there has been documented shellfish harvesting at the proposed marina site, it is necessary to determine if the proposed marina project would cause a loss of the shellfish harvesting use. A requirement for a buffer zone or other form of closure of the area for shellfish harvesting due to the proposed project would constitute a loss of the use. If the use would be lost, the 401 certification would be denied, if not, the certification could be given.

If there is no documented shellfish harvesting at the proposed marina site, the state should determine whether the existing water quality is suitable for the use to be attained and if physical conditions at the site allow its attainment. The first step is to determine whether the water quality is suitable or unsuitable. (For example, are the fecal coliform concentrations at the site suitable for shellfish harvesting?) Then an analysis should be made as to whether physical problems (such as substrate or flow) prevent the attainment. One means of determining the presence or absence of such physical problems would be the existence or lack of a shellfish resource.

If the use is found to be attainable, the state water quality agency must then determine whether the use would be lost if the marina project proceeded. If the use would not be lost, certification may be given. If the use would be lost (for example, by establishing a buffer zone where shellfish harvesting is prohibited), certification would be denied. If the use is found to be unattainable by the water quality agency, (for example, no shellfish are located at the site) 401 certification may be given.

For instances where shellfish harvesting is the designated use and is not considered the existing use and water quality criteria for this use can not be met, an applicant may wish to investigate with the state water quality agency whether this shellfish harvesting use is attainable. A use attainability survey, as described in the water quality standards regulations, can be conducted to make this determination. Such a survey may be performed by the applicant, the state water quality agency, the state shellfish resource agency or combinations of these groups. Based on the results of this study, if the state water quality agency determines that the use is attainable, then the certification would be denied. If the uses are determined to be unattainable, a water quality standards (and use classification) change could be initiated. Such a change would be necessary before certification could be given. A change in water quality standard requires extensive documentation and a public hearing. The state water quality agency makes decisions on certification and standards changes. If the shellfish resource is there and the water quality is suitable to allow harvesting, a change in the use classification is not allowable. If the shellfish are present, the water quality is suitable and the designated use is not shellfish harvesting, the shellfish resource is still protected under the provisions of antidegradation.

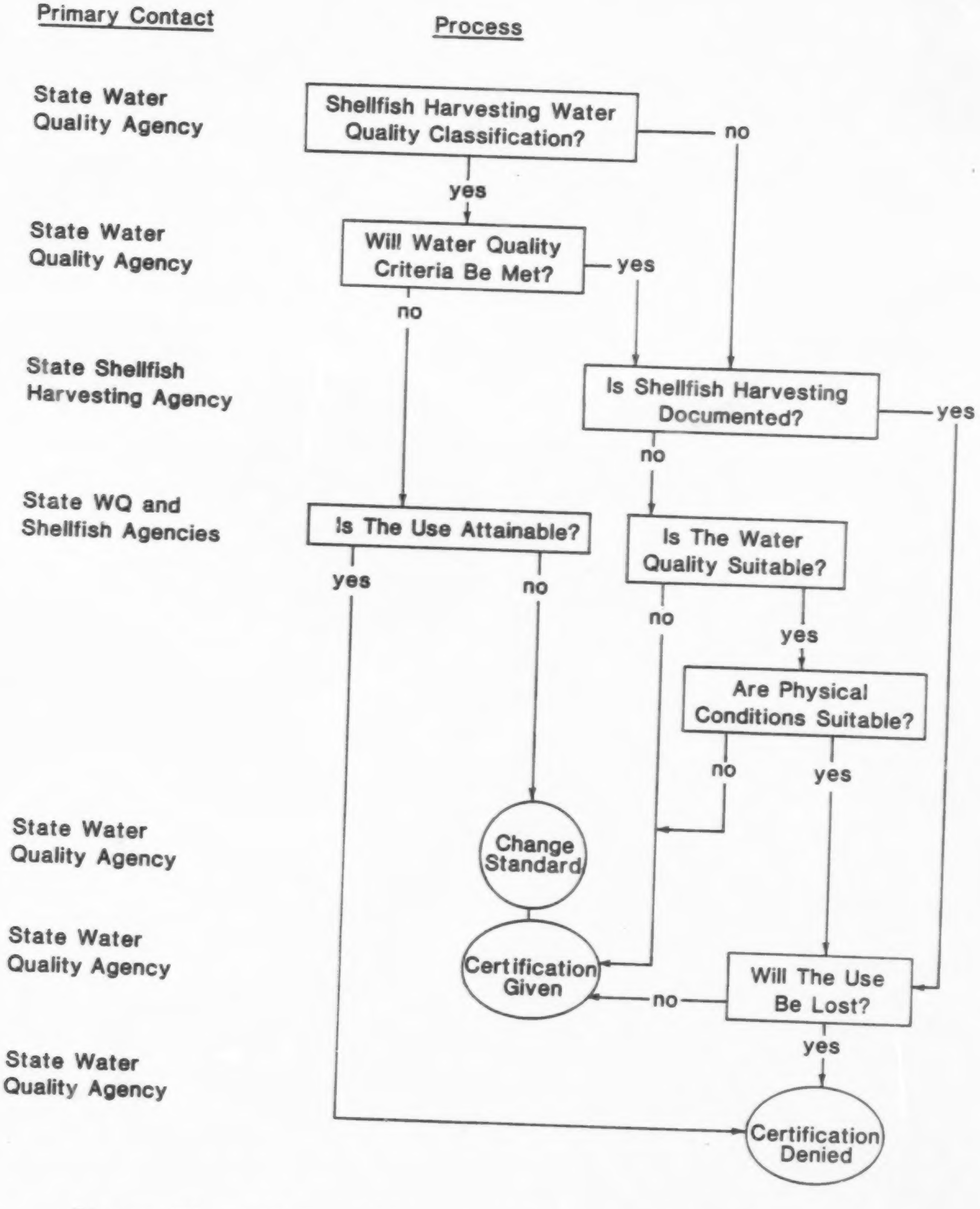
Primary Contact
Process
State Water Quality Agency
Shellfish Harvesting Water Quality Classification?
no
yes
State Water Quality Agency
Will Water Quality Criteria Be Met?
yes
no
State Shellfish Harvesting Agency
Is Shellfish Harvesting Documented?
yes
no
State WQ and Shellfish Agencies
Is The Use Attainable?
yes
no
Is The Water Quality Suitable?
no
yes
Are Physical Conditions Suitable?
no
yes
State Water Quality Agency
Change Standard
State Water Quality Agency
Certification Given
no
Will The Use Be Lost?
yes
State Water Quality Agency
Certification Denied

Figure 6A. Water quality certification in coastal waters.

6.3.5 Wetland Resources

Wetland resources, like aquatic habitat and water quality resources, are one of the key areas of concern of USACOE and state dredge and fill programs. The agencies involved and their functional roles are the same for wetland resources as for aquatic habitat resources. These agencies include:

- North Carolina Department of Natural Resources and Community Development, Office of Coastal Management
- South Carolina Coastal Council
- Georgia Department of Natural Resources, Coastal Resources Division, Coastal Marshlands Protection Committee
- Florida Department of Environmental Regulation
- Alabama Department of Environmental Management
- Mississippi Bureau of Marine Resources.

Each of these agencies has permitting authority which directly addresses wetland impacts. They also monitor general conditions in wetland areas, develop compliance through permit conditions and exercise enforcement authority.

6.3.6 Socioeconomic Resources

As discussed in Section 6.2, socioeconomic resources are not a major focus for permit programs applicable to coastal marinas.

The USACOE guidelines specify that permits should not be approved where there may be significant adverse impacts to economic resources. The state coastal management agencies have no direct permitting authority under this category. In some states, a state land lease is required. In Florida, FDCA, which is not a coastal area management agency, administers a permit program which addresses socioeconomic impacts. This permit program applies to marinas with 100 or more boat slips.

6.3.7 Navigation Resources

Under Section 10 of the River and Harbor Act, the USACOE has direct permit authority over virtually all work, including structures built in navigable waters.

The U.S. Coast Guard is responsible for maintaining necessary aids to navigation in navigable waters. Under this authority they would require marina operators to install necessary private navigational aids at the marina and from the marina area to the adjacent navigation channel. The USCG may delegate its authority over navigation to an approved state agency.

The only state agency identified as having a function related to navigation is the Alabama State Docks Department. ASDD requires construction permits for structures in water on navigable streams.

6.3.8 Aesthetic Resources

The fewest functional roles for federal and state regulatory agencies are for aesthetic resources (Table 6-1). Though many permit programs recognize the potential for impacts to aesthetic resources, it is a direct consideration for only one permit program. It is unlikely under most programs that adverse aesthetic impact alone would be the basis for denying a permit unless the impact represented a major visual intrusion on a significant resource area.

The North Carolina CAMA program recognizes aesthetic values in designating areas of environmental concern; therefore, this agency performs a resource management function for aesthetic resources. The CAMA permitting process, independent of NCOCM activities under the USACOE general permit, also directly considers aesthetic impacts.

6.4 Desirable Features of Regulatory/Planning Programs

Analysis of the state and federal regulatory/planning programs during the coastal marinas assessment revealed ways for enhancing the success of existing regulatory programs. Nine desirable features were identified through review and evaluation of agency roles and functions in the marina permitting process, interviews with state agency officials and consideration of review comments received from an interagency coordination committee. Descriptions of each of these nine desirable features follow.

FEATURE 1 - CLEARLY ESTABLISHED AND DESCRIBED AUTHORITIES AND RESPONSIBILITIES

Clearly defined authorities for the regulatory agencies would help identify where responsibilities overlap among agencies or where there are gaps in authority. This would help eliminate duplication of effort for both review agency and permit applicant and ensure a more thorough protection of coastal resources.

Clear definition of authority would allow the permit applicant to know precisely which agencies to contact and each agency's range of involvement. It would help the permittee determine what was required in the permit and ensure that all necessary permits were filed with the correct agencies.

FEATURE 2 - COORDINATION AMONG AGENCIES WHERE JOINT AUTHORITIES AND RESPONSIBILITIES EXIST

This feature is directly related to Feature 1. Because there are numerous areas where overlap of responsibilities and duplication of effort can occur among regulatory agencies, some formal means of coordination could help eliminate unnecessary expenditures of time and effort. Such formal coordination can be achieved through processes such as memoranda of understanding (MOUs), general permits or other interagency agreements.

FEATURE 3 - CONSISTENCY IN INFORMATION REQUIREMENTS OF APPLICANTS

This directly addresses the overlap of authority among regulatory agencies. Even if there are clearly defined areas of authority (Feature 1), and specific means for coordination (Feature 2), there could still be inefficient use of time and effort unless information requested from permittees is consistent among agencies. For example, even where joint permit application procedures have been established, federal and state agencies or even different state agencies may request different information in support of a single permit application. If similar types of data were requested at one time and in a consistent format, it could meet the requirements of all agencies and save both the applicant and review agency time and effort.

FEATURE 4 - CLEARLY ESTABLISHED AND DESCRIBED PERMIT FLOW DIAGRAMS AND TIME FRAMES

Flow diagrams and time limitations would provide a very useful device for tracking permit progress and consistency in the permit decision-making process. When clearly described, this information would allow both the permit applicant and the review agencies to know who was involved in each step of the decision-making process, when each of the processes would take place, and how long it should take.

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FEATURE 5 - PROVISIONS FOR FOLLOW-UP OF PERMITS THROUGH MONITORING AND COMPLIANCE

This desirable feature is a requirement for successful regulatory programs. There is no way to guarantee compliance with regulatory program objectives and permit conditions unless appropriate follow-up is carried out. With monitoring, marina developers and permitting agencies can assess the effectiveness of marina design and operation plans in meeting objectives and the success of mitigation strategies.

FEATURE 6 - CLEARLY ESTABLISHED AND DESCRIBED DECISION-MAKING CRITERIA

This is one of the most important features of those identified. It is necessary to have clearly established and described decision-making criteria in order to achieve consistency in decisions. This is an absolute requirement for legally defensible permit decisions. If objective criteria are clearly stated, applicants have a better understanding of what actions are likely to be permittable and the basis for making the permit decisions. With this understanding, the applicant is less likely to propose actions or to submit applications which are inappropriate. This would result in significant savings of time and manpower for both marina developers and regulatory agencies.

FEATURE 7 - PROVISIONS FOR OPTIONAL "FAST-TRACK" PERMITTING

Fast-track permitting could be beneficial to both permitting agencies and applicants in certain situations. This procedure would require identification of low or no impact marina projects. These projects would be identified by use of standardized criteria. The criteria would address all pertinent environmental concerns and could utilize a format similar to the siting checklist (Table 3-1). This would result in a streamlined approach that would reduce the permitting time for acceptable projects. Fast-track permitting could lessen the permit review load on the permitting agencies and aid the developer by scaling the complexity and cost of the review process to the specific project. There would be no circumvention of environmental concerns and development of low impact marina projects would be encouraged.

FEATURE 8 - ASSIGNMENT OF AGENCY REPRESENTATIVE AT INITIATION OF PERMITTING PROCESS TO ASSIST AND ADVISE APPLICANT

This approach is presently employed by some agencies. The agency representative can provide guidance to developer for achieving the most environmentally acceptable project, thereby saving the regulatory agency the time of reviewing applications for inappropriate sites. This approach provides the developer with a clearly identified and familiar contact, and, if necessary, a source of technical expertise for identifying mitigative alternatives.

FEATURE 9 - REGIONAL PLANNING FOR MARINA SITING

Regional planning for marina siting could reduce the number of individual permit reviews and, in theory, place the decision-making in a comprehensive, multidisciplinary context. Regional planning could promote more effective decision-making as well as reduce the number of application denials. Regional planning for coastal land uses currently is being carried out in at least three of the USEPA Region IV states.

6.4.1 Use of Desirable Features in USEPA Region IV

All regulatory agencies in USEPA Region IV with authority over some aspect of marina development have their authorities and responsibilities clearly defined in either state or federal statutes. The areas of authority and regulatory programs are further defined by most of the states in state regulations or administrative procedures. Although there are multiple agencies involved in review of marina development in each state, the possibility for duplication of effort for both applicant and review agency has been lessened by the adoption of joint programs in many states. In many cases only the application process is carried out jointly, with separate comment review, evaluation, and decision processes. Formal interagency agreements among state agencies apparently have not been adopted.

Most agencies use specific decision-making criteria contained in state statutes or regulations during the permitting process. While such specific criteria exist, many people find state statutes and regluations intimidating and not easy to understand. A good approach, used by some states, is to publish a separate pamphlet discussing the permitting process and the basis for decision-making.

The permitting process could be further strengthened in many states by publication of a flow chart that illustrates and describes the decision-making process. Such a chart could be made publicly available as an information pamphlet to be distributed at pre-application conferences. The USACOE, as well as some states, provide applicants just such a flow chart.

Both the USACOE and the state permitting agencies (except for Alabama, which only reviews an application for consistency with its coastal program and does not grant a permit) discuss the permitting process and decision criteria in a pre-application meeting. Some agencies also assign a point-of-contact to each permit applicant at this time. A pre-application meeting and the assignment of a point-of-contact, particularly if the contact is also a field representative, is a very beneficial procedure. Although the USACOE and the state permitting agencies encourage a pre-application meeting, in most cases there is not an established method of informing the applicant of this recommendation.

Many permitting programs have no fast-track permit process and standard time frames may also present problems. Fast-track permitting can have numerous advantages as discussed under Feature 7 in Section 6.4. Although overall time frames are often stipulated, time frames for subactivities such as receipt of application, comment period, review period, decision and appeals often are not specified.

All permitting agencies exercise some monitoring and compliance activities. Some rely on applicant self-monitoring, while others use field personnel for monitoring. Neither approach is necessarily more satisfactory. Regardless of who performs the work, continual or more frequent monitoring for certain parameters could be beneficial. Occasional or inconsistent monitoring does not give the regulatory agency an adequate idea of average daily conditions and also is less helpful to the developer. This type of monitoring can be interpreted by the developer as a "spot check" backed by the threat of enforcement actions. Conscientious developers seeking to provide a high quality development which meets or exceeds regulatory standards could be better served by consistent ongoing monitoring whether it be by agency staff or required of developers by the regulatory agencies.

The final area of regulatory program evaluation is the regional planning feature. Three states have some overall resource management authority, though only one state actually designates land/water areas where marinas would be a permitted or nonpermitted use. The regional planning approach can create some new problems and does not eliminate the need for site-by-site review and approval. However, if a regional planning approach were more widely used it could greatly decrease the number of inappropriate permit applications. This would save time and expense for permitting agencies and developers, and provide an additional mechanism for managing and protecting sensitive resources including unique natural areas and shellfish beds. The incorporation of desirable features in specific state programs is discussed in Section 6.5.2

6.5 Marina Regulation in USEPA Region IV

The principal federal and state permitting, certification and review agencies are listed by state in Appendix F. Appendix G contains sample permit application materials for each USEPA Region IV coastal state.

6.5.1 Federal Agencies

Federal involvement in the permitting of coastal marinas is primarily through the U.S. Army Corps of Engineers regulatory program. Corps authority to control marina siting is derived from Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act (CWA). Section 10 provides the Corps authority to control through its permit program construction in navigable waters and the excavation or deposition of any materials in navigable waters. Section 404 authorizes the Corps to issue permits for the discharge of dredged or fill material into waters of the United States. Section 10, in conjunction with other environmental laws, provides the Corps with authority to regulate any structure or work that may affect navigability, including associated impacts on other public interest factors. Section 404 authority focuses primarily on consideration of water quality issues and impacts on fish, shellfish and recreation associated with discharges of dredged or fill material. Certain responsibilities under Section 404 are shared with the Environmental Protection Agency (USEPA). Significant input to the process of evaluating permit applications under Sections 10 and 404 is also provided by the Department of Interior, Fish and Wildlife Service (USFWS) and the Department of Commerce, National Marine Fisheries Service (NMFS).

U.S. Army Corps of Engineers

Overall Permitting Process

The U.S. Department of the Army, Corps of Engineers is the sole federal marina permitting agency. The USACOE is responsible for reviewing marina permit applications and granting or denying a Section 10/Section 404 permit based on that review. In four of the USEPA Region IV coastal states (North Carolina and Alabama are excepted), there is a joint application process between the regional USACOE office and the applicable state permitting agency. In North Carolina, the USACOE has granted a general permit to the state and may approve Section 10/ Section 404 permits for activities approved by the state. In Alabama application is made only to the USACOE with the state exercising review of the USACOE permit. Although the permitting process is separate in most states, the USACOE will not grant a Section 10/Section 404 permit if the application is denied by the state permitting agency. General permit evaluation criteria used by the Corps and states are listed by coastal resource in Table 6-2.

The overall process followed by the Corps in reviewing permit applications, including marina development is shown on Figure 6-1. This diagram illustrates overall Corps responsibilities and decision points. The procedure shown would apply in general, to Corps reviews under any area of authority. Typically, when a Corps application form is utilized by an applicant only one form is submitted for both Section 10 and 404 approval and adequate information for both reviews is required. This general process has been modified to some extent based on memoranda of agreement signed by the Corps and state permit agencies.

The Corps' permit review process provides a clearinghouse for the collection and review of comments from public agencies at all levels of government, private groups and individuals. It also brings together comments representing the entire range of social, economic and environmental factors affected by marina development.

Following receipt of the permit application, the Corps undertakes a preliminary assessment to determine the type of environmental review required. This environmental review may range from a categorical exclusion to a full Environmental Impact Statement (EIS) procedure based upon

TABLE 6-2

GENERAL PERMIT EVALUATION CRITERIA

Impact category	Evaluation criteria	
	USACOE	State agencies
Water Quality	1. Compliance with applicable effluent limitations, water quality standards and management practices during construction, operation and maintenance.	1. Construction and operation must not result in water quality standards contraventions. 2. Adequate provision for dredged material disposal for life of project. 3. Need for maintenance dredging. 4. Demonstrated measures to minimize impacts on natural resources from marina or attendant boat operation. 5. Adequate waste disposal facilities and plans for meeting state requirements or specifications. 6. Adequate circulation and tidal flushing. 7. Measures to minimize possibility of spills. 8. Depth of basins and access channels not exceeding depth of receiving waters.
Aquatic Resources	1. Potential direct and indirect loss of or damage to fish resources.	1. Need for dredging in primary nursery areas. 2. Timing and location of dredging activities. 3. Adequate protection for natural resources in project and adjacent areas. 4. Proximity to shellfish and grassbeds. 5. Effect on conservation of shellfish and other marine resources. 6. Impact on marine resources or critical habitats.
Terrestrial Resources	1. Potential direct and indirect loss of and damage to wildlife resources.	1. Adverse impact to or interference with conservation of wildlife, critical habitats or other natural resources. 2. Air emissions that may degrade plant or animal life.
Wetland Resources	1. Unnecessary alteration or destruction of wetlands will be discouraged as contrary to the public interest. 2. Determine whether the coast line or base line might be altered.	1. Development in areas not requiring dredging or disruption of shallow water or wetland habitats. 2. Measures to minimize any necessary alteration 3. Excavation of boat basins in uplands or location on deep water site may be preferred.
Socioeconomic Resources	1. Probable impact marina and its intended use on the public interest, including nearby properties. 2. Extent of public and private need. 3. Effect on the enhancement, preservation or development of historic, scenic and recreational values.	1. Extent of public water use required. 2. Prominent display of nearest pumpout location and other appropriate waste disposal information. 3. Accomodation for disposal needs for maintenance dredging. 4. Adequacy of land access and parking facilities.

TABLE 6-2
(continued)

GENERAL PERMIT EVALUATION CRITERIA

Impact category	Evaluation criteria	
	USACOE	State agencies
Socioeconomic Resources (continued)		5. Designs should adequately serve commercial, sport fisheries and other recreational needs. 6. Plans for public safety. 7. Impact to historic, cultural and archaeological resources. 8. More efficient utilization of existing marinas. Innovative solutions to increased demand for services is encouraged.
Navigation Resources	1. Interference with public access to, or use of navigable waters. 2. Interference with a Federal project in navigable waters.	1. Other reasonable alternatives to construction and maintenance of access channels.
Aesthetic Resources	1. Impact on public interest with respect to scenic values and Wild and Scenic Rivers	1. Proper handling of litter and other refuse. 2. Interference with visual and physical access to coastal waters. 3. Preservation of natural scenic values.
Groundwater Resources	1. Potential impacts to wetland recharge areas and potable water supplies.	

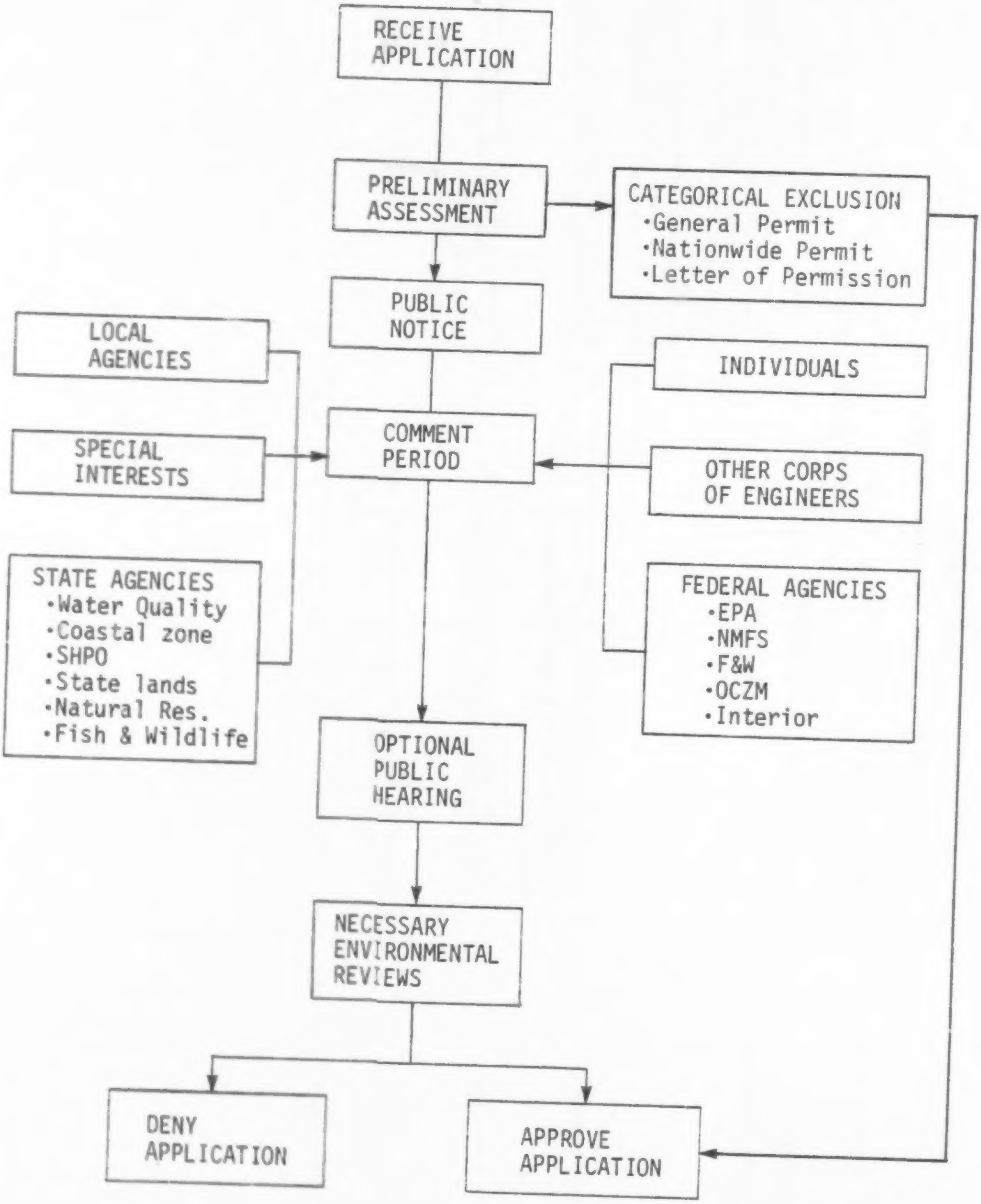
RECEIVE APPLICATION
PRELIMINARY ASSESSMENT
CATEGORICAL EXCLUSION
·General Permit
·Nationwide Permit
·Letter of Permission
PUBLIC NOTICE
LOCAL AGENCIES
INDIVIDUALS
SPECIAL INTERESTS
COMMENT PERIOD
OTHER CORPS OF ENGINEERS
STATE AGENCIES
·Water Quality
·Coastal zone
·SHPO
·State lands
·Natural Res.
·Fish & Wildlife
FEDERAL AGENCIES
·EPA
·NMFS
·F&W
·OCZM
·Interior
OPTIONAL PUBLIC HEARING
NECESSARY ENVIRONMENTAL REVIEWS
DENY APPLICATION
APPROVE APPLICATION

Figure 6-1. The U.S. Army Corps of Engineers permitting process.

the potential extent of adverse impact on the natural and manmade environment. A proposed activity is categorically excluded from further environmental review if the Corps finds that the project will have minimal or no individual or cumulative effect on environmental quality and that it will not cause an environmentally controversial change to existing environmental conditions.

When a categorical exclusion is not made, the next step in the permit process is for public notice to be given. This notice goes out to all interested parties along with those agencies with a required review or regulatory role in the process. The finding of the preliminary assessment may be included as part of the public notice.

A public hearing is held when it is determined necessary. This is based on review of comments from individuals, special interest groups, other Corps offices and public agencies. The permit application is then evaluated and the necessary environmental reviews, as determined in the preliminary assessment, are conducted. Following the completion of the environmental review, the permit decision is made and the permit is either issued or denied.

Basis for Decision-Making

Table 6-3 presents a summary of the criteria considered by the Corps in making permit decisions. Along with these criteria, the Corps considers the comments received in response to the public notice. In particular, comments of the USFWS and NMFS are addressed as required by the Fish and Wildlife Coordination Act, and USEPA criteria are met for siting of dredged material discharges under 404(b)(1) of the Clean Water Act. In general, the decision to issue or deny a permit is based on an assessment of the overall impact on the public interest. In the absence of overriding national factors of the public interest, a permit will generally be issued where a favorable decision has been received from the responsible state agencies. According to the Corps Section 404 regulations, a dredge and fill permit will be denied should any required federal, state or local authorization (including 401 Certification) be denied. This is reiterated in Section 401 regulations which state that if 401 Certification is denied, no other license or permit will be granted.

U.S. Environmental Protection Agency

The USEPA is involved in the permitting of coastal marinas through its joint responsibilities with the Corps for administration of the 404 Program and through its responsibilities under Sections 312 and 402 of the Clean Water Act. The USEPA's involvement under Section 404 includes:

- Development of criteria for evaluating locations for discharge of dredged material under 404(b)(1)

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TABLE 6-3

CORPS OF ENGINEERS PERMIT EVALUATION CRITERIA

- Evaluation of economic, social and environmental costs, versus benefits
- Extent of public and private need
- Desirability of alternative locations
- Cumulative impacts
- Effects on wetlands
- Conservation of wildlife and prevention of direct and indirect losses
- Evaluation for compliance with applicable effluent standards, water quality standards and management practices
- Consideration of effects on the enhancement, preservation or development of historic, scenic and recreational values
- Effects on wild and scenic rivers
- Effects on the limits of the territorial sea
- Interference with adjacent properties or water resource projects
- Impacts on navigation
- Compliance with state coastal zone management programs
- Evaluation of potential impact to marine sanctuaries
- Consistency with state, regional or local land use classifications, determinations or policies
- Effects on flood losses, impact of floods, human health, safety and welfare and the natural and beneficial values served by floodplains.

- Ultimate authority to veto the specification of a disposal site having unacceptable effects under 404(b)(1) guidelines
- The designation of geographic areas and ecosystems where the USEPA will make final determinations on permit applications
- Assistance to states in developing responsibility for delegated programs
- Determination of boundaries of waters of the United States
- The authority to halt illegal discharges.

The USEPA has developed detailed guidelines under 404(b)(1) (Table 6-4), which augment the general criteria used by the Corps in reviewing 404 permit applications (See Table 6-3). The USEPA has also developed additional guidelines that describe how discharges of dredged or fill material may impact the biological, ecological and chemical processes at a site. Specific procedures for evaluating the extent of the impacts are also provided. These guidance and evaluation procedures are found in 40 CFR 230, Subparts C through F.

Under Section 312 of the CWA, the USEPA was given the responsibility for promulgating federal standards of performance for marine sanitation devices (MSD). These standards basically prohibit discharges from marine sanitation devices into freshwater lakes and rivers except those bodies that support interstate navigation. For vessels operating in saltwater estuaries and the territorial seas, new vessels operating after January 30, 1980 must either not discharge or have an MSD capable of limiting fecal coliform bacteria and suspended solids to 200 MPN (most probable number) per 100 milliliters and 150 milligrams per liter, respectively. Older boats are still allowed to operate MSDs with lower levels of coliform and solids removal but are not permitted to use pump-through devices.

Under Section 402 of the Clean Water Act, either the USEPA or an approved state agency must grant a permit for any discharge other than dredged or fill material to the waters of the United States. This applies to any marina with an on-site sewage treatment system, greywater discharges from shower or washing facilities, or collection and discharge of waters from repair areas.

U.S. Fish and Wildlife Service and National Marine Fisheries Service

The USFWS and NMFS participate in the 404 process based on responsibilities under the Fish and Wildlife Coordination Act. The Act requires that impacts to fish and wildlife resulting from potential water resource development activities be fully considered. Both agencies are typically involved in coastal areas. When permits are reviewed, the USFWS considers whether alternative, non-wetland sites are available and whether construction can be accomplished without adverse impact to fish

TABLE 6-4

SUMMARY OF USEPA EVALUATION CRITERIA FOR PROJECTS PROPOSING DISCHARGE OF DREDGED OR FILL MATERIAL UNDER SECTION 404(b)(1) OF THE CWA

No discharge of dredged or fill material is permitted:

- Where practicable alternatives with less adverse impacts on the aquatic ecosystem and no other significant adverse impacts exist; such alternatives include:.
    - activities resulting in no discharge
    - alternative discharge locations
- If water quality standards would be violated
- If toxic effluent standards would be violated
- If the continued existence of endangered species would be violated
- Where requirements to protect marine sanctuaries would be violated
- Unless considerations of the economic impacts on navigations are overriding, where there are:
    - significant adverse effects on human health or welfare, municipal water supplies, plankton, fish, shellfish, wildlife and special aquatic sites
    - significant adverse effects on aquatic life and other aquatic-dependent wildlife
    - significant adverse effects on aquatic ecosystem diversity, productivity and stability
    - significant adverse effects on recreational, aesthetic and economic values

Specific procedures for making these determinations have been set forth in Subparts C through F of 40 CFR 230.

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and wildlife in aquatic, terrestrial or wetland habitats. NMFS reviews applications for potential impacts to aquatic and wetland resources as they affect commercial fisheries. Comments received from these agencies by the Corps are reviewed extensively and are quite important in the decision-making process. Tables 6-5 and 6-6 list the criteria considered by these two agencies in reviewing and commenting on Corps 404 applications.

U.S. Coast Guard

Under the CWA, the U.S. Coast Guard has responsibility for enforcing regulations controlling MSDs. This includes requirements for vessel manufacturers and vessel operators, and procedures for evaluation and certification of performance for all MSDs. The Coast Guard also reviews applications with respect to boating safety and navigation.

6.5.2 State Agencies

The coastal states in USEPA Region IV play a major role in the permitting of marina developments. Although there is broad variation from state to state in the type of approval required and the way in which the regulatory programs are administered, every state still has some major authority to control marina development.

The minimum level of state participation is review and comment on Section 10 permit applications. When Section 404 permits also are required the states must provide a certification to the Corps under Section 401 of the CWA that the proposed activity will not result in any violation of state water quality standards throughout the construction phase and subsequent operation of the facility. Under Corps regulations, states (with the exception of Georgia) must also comment on applications submitted to the Corps to indicate that any other state license, permit or approval can be secured. Without this assurance, the Corps will not approve the 404 Permit. Also, based on requirements of the Fish and Wildlife Coordination Act, the state fish and wildlife agencies must comment to the Corps along with USFWS and NMFS.

The next level of state involvement is a consistency review of the Corps permit action under the State Coastal Zone Management Program. Under Section 307(c) of the Coastal Zone Management Act, any applicant for a federal license or permit to conduct any activity affecting a state's coastal zone must furnish a certification that the activity will be consistent with the goals of the state coastal zone program. The state will review these certifications, and unless it is in agreement, the application for a 404 Permit will be denied by the Corps. This provision is effective only in states where a coastal zone management program has been approved by the Secretary of Commerce.

The above state actions only involve review and approval actions as part of the Corps regulatory program. The highest level of state involvement is reached in those states where a separate state regulatory

TABLE 6-5

U.S. FISH AND WILDLIFE SERVICE CRITERIA FOR MARINA SITING EVALUATION

- Marinas with docks and piers that extend out from the shoreline far enough not to require dredging of the shallow shoreline would be preferable as a means of gaining access to deep water. These docks could either be floating or elevated on piles. The marina breakwater should either be a floating type or should allow for adequate circulation within the enclosure in other ways (e.g., leaving the bottom of the breakwater open, leaving openings every few inches along the breakwater, leaving the area near shore open)

- In areas where extending the dock into deep water is not possible, excavation of basins in uplands would be the next choice

- The marina should be sited so that dredging of access channels is kept to a minimum. Access channels should not be dredged through submerged grass or shellfish beds

- The use of elevated boat lifts instead of dredged basins should be considered in areas where smaller boats are to be docked and deep water is accessible without dredging through sensitive habitats

- The entrance channel should be well marked and boaters should be required to stay within the designated channel to reduce the possibility of boat traffic tearing up nearby submerged grass beds or causing siltation problems

- The entrance to the marina should be at least 1,000 feet from shellfish harvesting areas to reduce the possibility of polluting or silting these areas

- The turning basins and navigation channels should not be designed to create a sump that would result in long-term degradation of water quality. For example, the depth of the boat basin and access channel should not exceed that of the receiving body of water, and should not be located in areas of poor water circulation

- The depth of the basin should not exceed the depth of light penetration through the water column. If greater depths are necessary for deeper draft boats, these boats should be docked near the entrance to the basin so that the basin depth could be reduced sloping upward from the receiving body of water

- The design should not disrupt currents or restrict the the tidal flow. Often a flushing channel would be a beneficial addition to the design to provide another entrance for tidal waters

TABLE 6-5
(continued)
U.S. FISH AND WILDLIFE SERVICE CRITERIA FOR MARINA SITING EVALUATION

- Permanent spoil disposal sites should be set aside in non-wetland areas for use in initial contruction and future maintenance dredging. The site should be designed to contain the material in such a manner so as to prevent dispersal into adjacent wetland areas. All effluent from the disposal area should be directed back into the basin being dredged and should be monitored to insure that it meets all water quality standards

- At the entrance and within the basin, sloping riprap, gabions, or vegatation should be used as stabilization rather than vertical seawalls. Where bulkheads are essential, a shallow zone should be maintained against the bulkheads with not more than a 3:1 slope starting at least 10 feet from the bulkhead

- Sharp angles and turns that may collect debris or cause shoaling or flushing problems should be avoided within the basin

- Project proposals should include facilities for the proper handling of petroleum products, sewage, litter, and other refuse. Current federal regulations regarding holding tanks should be enforced

- For marinas dredged into upland sites, the basin should be dredged and the shoreline stabilized before the "plug" is removed connecting the basin with open water in order to reduce the detrimental effects of turbidity and siltation produced during excavation. In other areas, designs for the excavation project should include protective measures such as silt curtains, diapers, or weirs

- Berms and swales should be made part of the marina design so that there is a gradual slope away from the edge of the basin. This will help prevent introduction of contaminants into adjacent open water and wetland areas

- All development near the marina should be on a central wastewater treatment facility as opposed to septic systems which could leach polluted groundwater into the marina.

TABLE 6-6

NATIONAL MARINE FISHERIES SERVICE GUIDELINES FOR WETLAND ALTERATION

GENERAL CONSIDERATIONS

In assessing the potential impacts of proposed projects, the NMFS is guided by the following seven considerations:

- The extent of precedent setting and existing or potential cumulative impacts of similar or other developments in the project area
- The extent to which the activity would directly affect the production of fishery resources (e.g., dredging, filling marshland, reduced access, etc.)
- The extent to which the activity would indirectly affect the production of fishery resources (e.g., alteration of circulation, salinity regimes and detrital export)
- The extent of any adverse impact that can be avoided through project modification or other safequards (e.g., piers in lieu of channel dredging)
- The extent of alternative sites available to reduce unavoidable project impacts
- The extent to which the activity requires a waterfront location if dredging or filling wetlands is involved
- The extent to which mitigation is possible to offset unavoidable habitat losses associated with a water-dependent project that clearly is in the public interest.

Marinas

All marinas affect aquatic habitats to some degree, but adverse effects can be minimized with proper location and design. In addition to guidelines for bulkheads and seawalls, the following apply:

- Marinas should be located in areas where maximum physical advantages exist (e.g., where the least initial and maintenance dredging will be required)
- Design should not disrupt currents or restrict the tidal flow
- Marinas should be located at least 1,000 feet from shellfish harvesting areas, unless state regulations state otherwise
- Open dockage extending to deep water is a preferable alternative to the excavation of boat basins; where not possible, excavation of basins in uplands is generally preferred

TABLE 6-6
(continued)
NATIONAL MARINE FISHERIES SERVICE GUILDELINES FOR WETLAND ALTERATION

- Turning basins and navigation channels should not be designed to create a sump that would result in long-term degradation of water quality. For example, the depth of boat basins and access channels should not exceed that of the receiving body of water, and should not be located in areas of poor water circulation
- Filling or dredging of vegetated wetlands for marina construction is unacceptable
- Marinas should not be sited in areas of known high siltation and shoaling rates
- Permanent spoil disposal sites should be set aside in non-wetland areas for use in initial construction and future maintenance dredging
- Marinas should be designed to ensure adequate flushing and should not create a sump; they should be no deeper than the parent body of water and aligned with prevailing summer winds to take advantage of wind-driven circulation
- When marinas are built in proximity to grassbeds, channel routes should be clearly marked to avoid damage to the grassbeds by propellers and propwash.

Bulkheads and Seawalls

Bulkheads are retaining structures used to protect adjacent shorelines from the action of currents or waves, or to make waterfront more accessible. A common practice has been to erect vertical seawalls in the water and then place fill material on the landward side of the structure. This technique has often been ineffective in terms of protection and is disruptive to marine productivity. To mitigate these environmental losses, the following criteria apply:

- Except under special circumstances such as severely eroding shorelines from a recent storm, structures should be aligned no further waterward than the existing shoreline (upland boundary) and constructed so the reflective wave energy does not destroy adjacent fishery habitat or wetlands
- Where possible, sloping (3:1) rip-rap, gabions, or vegetation should be used rather than vertical seawalls.

program controlling marina development has been implemented. Different states have taken different approaches to direct regulation of marina activities. Some states have developed a wetland or coastal area permit as part of the coastal zone management program while other states have developed separate wetland or marshland permitting programs. Some states also have developed dredge and fill permit programs.

An additional means of regulating marina development is through control over state ownership of submerged lands. Though the extent of ownership varies among the states, most states do claim title to submerged lands. In some of the USEPA Region IV coastal states, this claim results in a requirement that marina owners lease the bottoms over which their development is located.

More than one of these regulatory programs have been implemented in some states. In Florida, for example, in addition to required input to the Corps permit review process, there is a state dredge and fill permit program, a state review program for developments of regional impact, two separate permit programs administered by Florida DNR and DER and a requirement for a submerged land lease from DNR. For all the USEPA Region IV states, whatever the approach taken, the program must be carried out in liaison with the Corps' permit program. Different procedures for carrying out this liaison have been developed by the Corps and each of the states in USEPA Region IV. The following sections describe the overall state programs in more detail and discuss the various criteria used in decision-making, water quality criteria as they relate to marina development and 401 Certification, and the permit conditions and mitigative measures typically applied to marina developments.

North Carolina

Overall Permitting Program

The process for permitting coastal marinas in North Carolina is unique among Region IV states. Unlike other states, North Carolina has received general permit authority from the Corps. The terms of the permit authorize construction activities covered under Section 10 and Section 404, if they receive prior permit approval from the state. Without required federal, state or local approval (including 401 Certification), Section 404 and Section 10 Permits will not be granted. With this arrangement, the role of the Corps is different from that in most states. Instead of a duplicate permit review process parallel to that of the state, the Corps serves more of a review and final authorization role. Figure 6-2 schematically represents the marina permitting process in North Carolina. The diagram shows the absence of continuous Corps involvement from top to bottom. Instead, at certain points in the state review process there is a lateral coordination with the Corps.

The primary state regulatory program for marina development in North Carolina is the Coastal Area Management Act (CAMA) permit program operated by the State Department of Natural Resources and Community

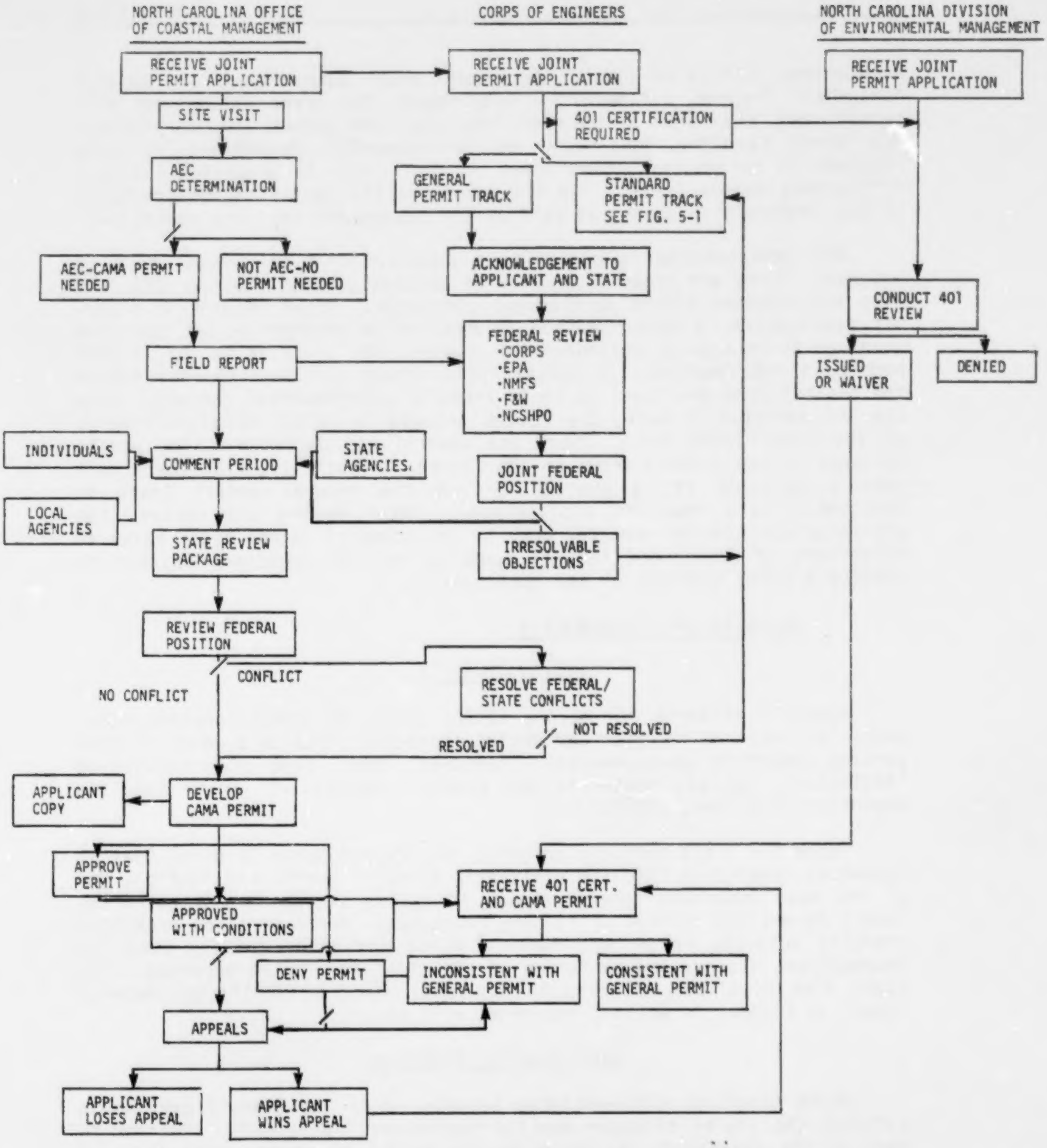
NORTH CAROLINA OFFICE OF COASTAL MANAGEMENT
CORPS OF ENGINEERS
NORTH CAROLINA DIVISION OF ENVIRONMENTAL MANAGEMENT
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
SITE VISIT
401 CERTIFICATION REQUIRED
AEC DETERMINATION
GENERAL PERMIT TRACK
STANDARD PERMIT TRACK SEE FIG. 5-1
AEC-CAMA PERMIT NEEDED
NOT AEC-NO PERMIT NEEDED
ACKNOWLEDGEMENT TO APPLICANT AND STATE
CONDUCT 401 REVIEW
FIELD REPORT
FEDERAL REVIEW •CORPS •EPA •NMFS •F&W •NCSHPO
ISSUED OR WAIVER
DENIED
INDIVIDUALS
COMMENT PERIOD
STATE AGENCIES
JOINT FEDERAL POSITION
LOCAL AGENCIES
STATE REVIEW PACKAGE
IRRESOLVABLE OBJECTIONS
REVIEW FEDERAL POSITION
CONFLICT
NO CONFLICT
RESOLVE FEDERAL/ STATE CONFLICTS
NOT RESOLVED
RESOLVED
APPLICANT COPY
DEVELOP CAMA PERMIT
APPROVE PERMIT
RECEIVE 401 CERT. AND CAMA PERMIT
APPROVED WITH CONDITIONS
DENY PERMIT
INCONSISTENT WITH GENERAL PERMIT
CONSISTENT WITH GENERAL PERMIT
APPEALS
APPLICANT LOSES APPEAL
APPLICANT WINS APPEAL

Figure 6-2. North Carolina marina permitting process.

Development, Office of Coastal Management under authority of the Coastal Management Program. A separate requirement for state dredge and fill permits has also been integrated into the CAMA permit review process. The North Carolina Department of Environmental Management is also involved in marina permitting based on their role in providing 401 certifications to the Corps. The 401 Water Quality Certifications pertains to the construction phase, as well as the subsequent facility operation.

The CAMA program is basically a coastal "critical areas" type of program. There are broad categories of critical areas in which CAMA permits are required before development can occur. After receipt of a permit application, a determination is made as to whether or not the area involved is an area of environmental concern (AEC). If it is not, a CAMA permit is not required. In actual fact, almost all developments within the coastal zone are found to be in areas of environmental concern. Once the AEC decision is made, the review process is fairly straightforward, as shown on Figure 6-2. There are several key decision-making points included in the process shown on the figure. Initially, the Corps must make a decision as to whether or not the general permit track is applicable to a specific application. Later during the review, the entire process can be reverted back to the standard permit track based on objections of state and federal agencies or the agencies' failure to develop a joint position on the application.

Basis for Decision-Making

Siting Criteria

Specific criteria for marina siting along the North Carolina coast emphasize required location and design characteristics as a means of conserving important environmental features and also of safeguarding "biological, social, aesthetic and economic values..." (North Carolina Administrative Code, 1983).

Table 6-7 lists specific criteria used by the North Carolina Coastal Resources Commission (CRC) in evaluating a marina permit application. One of the most important considerations in marina siting is the potential impact on wetland habitat or fishery resources. North Carolina prohibits dredging activity in primary nursery areas and areas chiefly used for propagation, storage and gathering of shellfish for market purposes. The state also disallows activity in any area where a significant adverse impact on fishery or wetland resources will result.

Water Quality Criteria

North Carolina differentiates between water use classifications in defining the limits of water quality parameters (Table 6-8). Changes in each of the parameters may occur as the result of marina development or operation. For instance, wastes discharged from marine sanitation devices may affect values for floating solids, pH, dissolved oxygen or coliform counts in receiving waters. Toxic wastes, such as oils, can result

TABLE 6-7

STATE OF NORTH CAROLINA MARINA PERMIT EVALUATION CRITERIA[a]

- Dredging activities are not approved in primary nursery areas
- Development is preferred in non-wetland sites or in deep waters which require no dredging; development should not disturb valuable shallow water or wetland habitat, except for dredging necessary for access to high ground
- Marinas requiring dredging must provide areas to accommodate disposal needs for future maintenance dredging
- Sites in order of preference:
  - upland site with no alteration of wetland or estuarine habitat and providing adequate flushing by tidal or wind-generated water circulation
  - upland site with dredging for access if dredging will cause no significant adverse impact on fishery or wetland resources
  - deep water site (not primary nursery area); no excavation or wetland alteration
  - site requiring excavation of relatively unproductive estuarine substrate to a depth no greater than depth of connecting channels
- Mixture of dry storage areas, public launching facilities and berthing spaces is considered
- The sign of the marina must provide the following information:
  - location of nearest pumpout facility
  - telephone numbers of local septic tank pumping services
  - other appropriate waste disposal information
- Demonstrate implementation of means and measures to be used to minimize impact of pollutants likely to be emitted by marina and attendant vehicle operation on natural systems, to include providing grease and sediment traps for storm water runoff
- Use methods that will minimize adverse effects on navigation and public water use while allowing applicant adequate access to deep water
- Activity shall not be enclosed within breakwaters that preclude circulation sufficient to maintain water quality.

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[a] NCDNER, 1983.

TABLE 6-8

STATE OF NORTH CAROLINA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classification Potentially Impacted by Marina Siting		
Parameter	Class SA[b]	Class SB[c]	Class SC[d]
Floating Solids, Settleable Solids & Sludge Deposits	None, attributable to sewage, industrial or other wastes	Same as Class SA	Only such amts. from sewage, industrial or other wastes, as will not make waters unsafe or unsuitable for fish, shellfish & wildlife or impair water for any other best usage in this class
Sewage, Industrial or Other Wastes	None not treated to satisfaction of established standards	Same as Class SA	
pH	6.8-8.5	Normal for area waters, gen. 6.8-8.5	Normal for area waters, gen. 6.0-8.5. Swamp waters: min.4.3
Disolved Oxygen	Not < 5.0 mg/l swamp waters: less if caused by natural conditions	Same as Class SA	Same as Class SA
Toxic Wastes, Oils; Deleterious Substances; Colored or Other Wastes	Only such amts. as will not make the waters unsafe or unsuitable for fish & shellfish or their propagation, impair palatability or impair waters for any other best usage in this class	Only such amts. as will not make the waters unsafe or unsuitable for bathing, injurious to fish or shellfish or adversely affect palatability, or impair the waters for any other best usage in this class	Only such amts. as will not render water injurious to fish & shellfish, adversely affect palatability or impair waters for any other best usage in this class
Manganese	0.1 mg/l		
Organisms of Coliform Gp.	Total Gp not > median MPN or MF of 70/100ml & not > 10% of samples shall exceed an MF count of 230/100ml in areas most probably exposed to fecal cont. during most unfavor. hydrographic & pollution conditions	May-Sept.: fecal coliforms not > log mean of 200/100 ml (MPN or MF) based on 5 or more consec. samples examined during any 30-day pd. & not > 400/100 ml in more than 20% of samples examined during such pd. (not during or after rainfall) (Oct-April: See Class SC)	Fecal coliforms not log mean of 1000/100ml (MPN or MF) based on 5 or more samples examined in 30-day pd. nor > 2000/100ml in more than 20% of samples during such pd. (not during or after rainfall)

TABLE 6-8
(continued)
STATE OF NORTH CAROLINA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

Parameter	Class SA[b]	Class SB[c]	Class SC[d]
Temperature	Not increased above natural water temp. by more than 0.8°C (1.44°F) during June, July and August, not more than 2.2°C (3.96°F) during other months; never more than 32°C (89.6°F) due to discharge of heated liquid.	Same as Class SA	Same as Class SA

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[a] NCDNER, 1979.

[b] Shellfishing for market purposes and any other usage specified by "SB" or "SC" classification. Waters will meet sanitary and bacteriological standards in 1965 revision of "National Shellfish Sanitation Program Manual of Operations: Part 1, Sanitation of Shellfish Growing Areas.

[c] Primary recreation and any other usage specified by the "SC" classification.

[d] Fishing, secondary recreation and any other usage except primary recreation or shellfishing for market purposes.

from spillage during boat refueling operations or engine cleaning, or from accidental spills during construction.

State guidelines for marina siting require that measures must be taken to minimize the impact of pollutants likely to be emitted by marina operation. Grease and sediment traps could be used, for example, to control storm water runoff. In addition, siting guidelines, such as not enclosing marinas in breakwaters that preclude circulation, are established to help maintain water quality.

Dredge and Fill Requirements

North Carolina generally discourages dredging in wetland areas unless it is a necessity to gain access to upland sites. Whatever the case, dredging is prohibited in primary nursery areas.

High-ground spoil disposal sites for future maintenance dredging must be provided with adequate stabilization measures to prevent sediments from entering adjacent water bodies and marshes. State requirements for dredge spoil are listed in Table 6-9.

Permit Conditions and Mitigative Measures

Table 6-10 presents examples of permit conditions or measures to mitigate potential problems that could violate state regulations regarding the development of marinas. In most cases, the conditions must be met or it must be shown that they will be met prior to state approval.

The conditions listed in Table 6-10 are imposed to protect the existing water quality and natural state of the environment during construction (i.e., use of sediment screens during dredging). These conditions are intended to insure that pre-construction environmental conditions are maintained or enhanced after construction is completed (i.e., vegetation or submerged grasses).

Summary of North Carolina Permit Process

The North Carolina permit process is a streamlined approach to coordination between the Corps 404 Permit responsibilities and a comprehensive state regulatory program. The general permit approach eliminates much of the duplication of effort that takes place when state regulatory controls are exercised along with the Corps. The process appears to provide simplified procedure with clear lines of authority. This program provides for monitoring and compliance procedures and has a separate fast-track process for small projects. Another important feature is the field service representative, a staff member who serves as a point of contact for the permit applicant. This representative assists in site evaluation and provides recommendations on alternative site development and environmental solutions to marina impacts. Although there is no regional planning specifically for marina developments, the CAMA program has directly encouraged overall land use planning in coastal counties.

TABLE 6-9

STATE OF NORTH CAROLINA

DREDGE AND SPOIL REQUIREMENTS[a]

- Position terminal end of dredge pipeline at a sufficient distance to preclude erosion of containment dike and at a minimum distance from spillways to allow adequate settlement of suspended solids
- Confine spoil on high ground by adequate retaining structures, or deposit it on beaches for nourishment, if spoil material is acceptable
- Confine spoil on high ground landward of regularly and irregularly flooded marshland with soil stabilization measures that prevent entry of sediments into adjacent water bodies or marshes
- Effluent from diked areas receiving disposal from hydraulic dredging operations must be contained by pipe, trough or similar device waterward of emergent vegetation or below mean low water
- Return effluent from diked disposal areas to area being dredged when possible
- Water control structure must be installed at intake end of effluent pipe
- Publicly funded projects are considered on case-by-case basis with respect to dredge and spoil methods
- Dredge spoil from closed shellfish waters and effluent from diked disposal areas used when dredging in closed shellfish waters shall be returned to closed shellfish waters.

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[a] NCDNER, 1983.

TABLE 6-10

STATE OF NORTH CAROLINA

EXAMPLES OF MARINA PERMIT CONDITIONS[a]

- Seasonal limitations on dredging to protect juvenile fish and shellfish
- Revegetation of submerged grasses
- Grading of channel and basin bottoms to aid flushing
- Use of sediment screens during dredging
- Confine excavated materials above mean high water and landward of regularly or irregularly flooded marsh behind adequate dikes or other retaining structures to prevent spill-over into marsh or surrounding waters
- No marsh excavated or filled outside alignment on plats
- Keep underground waste disposal fields at least 100 feet from surface water and no less than 4 feet above groundwater tables
- Install water control structure at intake end of effluent pipe to assure compliance with water quality standards.

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[a] State of North Carolina, Department of Natural Resources and Community Development and Coastal Resources Commission Permit.

The permit applied for through the Department of Natural Resource and Community Development, Office of Coastal Management (DNRCD/OCM) is the Coastal Area Management Act (CAMA) permit. A permit application can be obtained from the USACOE Wilmington District Office or from the Office of Coastal Management (including any one of the four regional offices). A sample copy of the joint permit application is included in Appendix G. The application itself lists any other items that must be provided by the developer with the application and, also, where to forward the completed application.

The permit application must be submitted jointly to the USACOE and to the Office of Coastal Management. Examples of permit application materials for each Region IV coastal state are provided in Appendix G. The permitting process in North Carolina is unique in that the state has received general permit authority from the USACOE Wilmington District for construction activities under Section 10/Section 404 permits. The USACOE authorizes activities if they receive permit approval from the state. The OCM makes a permit decision within 75 days of receipt of a completed application. This decision may be delayed if extended agency review is required or if there is a conflict between the federal and state positions. Although an application is to be submitted following site selection, both the Corps and the OCM recommend a pre-application meeting prior to application submittal.

The DNRCD, Division of Environmental Management reviews the permit application and notifies the USACOE of its decision on 401 water quality certification. The application for a CAMA permit serves as a request for water quality certification.

The following state agencies are routinely solicited by the Office of Coastal Management for comments on a permit application:

- Field Services Section, Office of Coastal Management
- State Property Office
- Division of Archives and History
- Division of Community Assistance
- Land Quality Section, Division of Land Resources
- Division of Highways, Department of Transportation
- Environmental Operations Section, Department of Environmental Management
- Wildlife Resources Commission
- Office of Water Resources
- Division of Health Services.

Review comments and/or recommendations are forwarded to the Office of Coastal Management. A decision on the application is not made until all appropriate agencies have commented and all issues are resolved.

South Carolina

Overall Permitting Program

The South Carolina permit program is a special permitting program under authority of the South Carolina Coastal Council which requires a permit for construction in tidal waters. In addition to this program, marina development in South Carolina must also receive Section 404 Permits from the Corps and a 401 Certification from the Department of Health and Environmental Control (DHEC). Although these three separate approvals are required, the procedure has been coordinated somewhat by the use of a joint permit process by the Corps and the Coastal Council. The overall permitting process for South Carolina is shown in Figure 6-3.

The permitting process is fairly straightforward and typical of states where joint programs have been implemented. The starting point is the submission of a joint permit to the Coastal Council which then forwards a copy to the Corps. A request for 401 Certification then goes out from the Corps to DHEC. Should DHEC deny 401 certification, the Corps, pursuant to their Section 404 regulations, will deny a Dredge and Fill Permit. Should the 401 Certification be granted, it will pertain to both project construction and subsequent facility operation.

The joint program procedure results in only one permit application being required. A joint public notice is given and a joint public hearing can be held where it is deemed necessary. In all other respects, however, there are really two separate permitting actions plus the 401 Certification review being carried out. Both state and federal agencies receive and review comments, and in the end, the process results in two separate approvals (the Coastal Council and the Corps) being granted.

Basis for Decision-Making

Siting Criteria

The South Carolina Coastal Council evaluation criteria for marina siting are found in Table 6-11. South Carolina has an extensive list of location requirements that generally must be met prior to approving a marina permit. The location must have minimal adverse impact on the natural biological environment of an area. Detrimental impacts must be assessed before construction can be approved, particularly in shellfish areas. In addition, where shellfish areas may be involved, the rights of both the lessee (if applicable) and the public must be considered initially at the onset.

The South Carolina Wildlife and Marine Resources Department, Marine Resources Division considers the issue on lessee rights in the policy/guidelines they developed to help regulate marina siting. Marina siting criteria specified in these guidelines are:

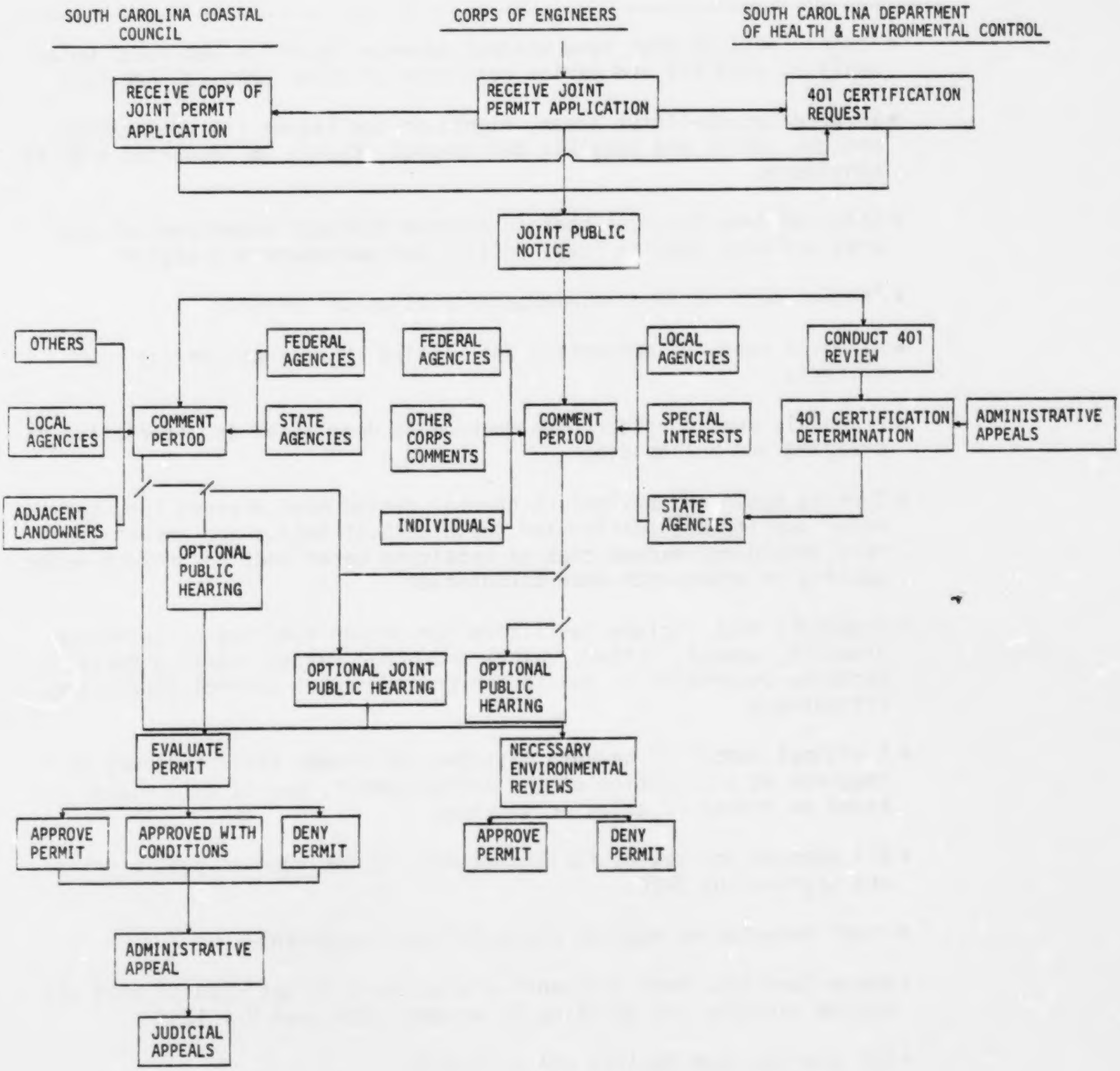
SOUTH CAROLINA COASTAL COUNCIL
CORPS OF ENGINEERS
SOUTH CAROLINA DEPARTMENT OF HEALTH & ENVIRONMENTAL CONTROL
RECEIVE COPY OF JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
401 CERTIFICATION REQUEST
JOINT PUBLIC NOTICE
OTHERS
LOCAL AGENCIES
ADJACENT LANDOWNERS
COMMENT PERIOD
FEDERAL AGENCIES
STATE AGENCIES
FEDERAL AGENCIES
OTHER CORPS COMMENTS
INDIVIDUALS
COMMENT PERIOD
LOCAL AGENCIES
SPECIAL INTERESTS
STATE AGENCIES
CONDUCT 401 REVIEW
401 CERTIFICATION DETERMINATION
ADMINISTRATIVE APPEALS
OPTIONAL PUBLIC HEARING
OPTIONAL JOINT PUBLIC HEARING
OPTIONAL PUBLIC HEARING
EVALUATE PERMIT
NECESSARY ENVIRONMENTAL REVIEWS
APPROVE PERMIT
APPROVED WITH CONDITIONS
DENY PERMIT
APPROVE PERMIT
DENY PERMIT
ADMINISTRATIVE APPEAL
JUDICIAL APPEALS

Figure 6-3. South Carolina marina permitting process.

TABLE 6-11

STATE OF SOUTH CAROLINA

MARINA PERMIT EVALUATION CRITERIA[a]

- Chosen location must have minimal adverse impact on wetlands, water quality, wildlife and marine resources or other critical habitats
- In affected shellfish areas, rights of the leasee (if applicable) and the public and possible detrimental impacts on resources must be considered
- Selected location must contain maximum physical advantages of the area and must require least initial and maintenance dredging
- Project must avoid or minimize disruption of currents
- Minimize need for excavating and filling shorelines (design criteria)
- Proposals must consider open dockage to deep water as alternative to dredging and bulkheading
- Turning basin and navigation channel design must prevent long-term water quality degradation and depth of boat basins and access channels should not exceed that of receiving water body to protect water quality in areas with poor circulation
- Proposals must include facilities for proper handling of petroleum products, sewage, litter, waste, and other refuse, meeting South Carolina Department of Health and Environmental Control (DHEC) specifications
- A minimal number of onshore restroom and shower facilities may be required as a condition of any marina permit, and is determined based on number of slips or moorings
- All pumpout and sewage facilities must be included in public notice and approved by DHEC
- Trash receptacles must be plentiful and convenient
- Where feasible, boat maintenance areas must be designed so that all bottom scraping and painting is accomplished over dry land
- Dry storage type marinas are preferred
- Applications for marina construction will be considered only after adequate demonstration of facilities demand
- Application must include maintenance dredging schedules and dredged material disposal sites (if applicable).

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[a] South Carolina Coastal Council, 1981.

- A leaseholder or tenant of state property used for commercial shellfish culturing cannot grant or cede a portion of his lease to a conflicting interest (i.e., marina siting)
- A Public Oyster Ground (POG) will not be considered for closure through pollution incursion from proposed marinas and associated developments.

Water Quality Criteria

In order to protect the existing water quality marina permit evaluation criteria require that the design of boat basins and access channels be such that circulation is maintained, particularly in areas of poor circulation. In addition, proper facilities for handling petroleum products, sewage, litter, waste and other refuse must be specified in the proposals to protect inherent water quality as much as possible.

Water quality parameter limits for use classifications applicable to marina siting are presented in Table 6-12. These limits are basically the same as for North Carolina and include levels of fecal coliform, pH and dissolved oxygen levels resulting from MSD discharges, and oily waste pollution from engine maintenance, refueling and accidental spills during marina construction. In addition, South Carolina water quality standards include a turbidity standard. The most valuable waters from an ecological standpoint, Class SAA (Table 6-12), require that under no circumstances can turbidity be greater than existing natural levels. Dredging for marina construction can increase turbidity past acceptable levels unless preventive measures are taken.

Dredge and Fill Requirements

The South Carolina Coastal Council requirements for dredging and spoil disposal can be found in Table 6-13. Dredging is discouraged but, if no feasible alternative exists such as open dockage to deep waters, then the location needing the least amount of initial and maintenance dredging is preferred. An application for marina construction will not be approved unless a maintenance dredging schedule and a spoil disposal site are included on the application. Use of existing sites is recommended but, if this is not possible, then maintenance dredging and spoil disposal in upland sites must be handled in such a manner that dispersal into wetlands is avoided.

Permit Conditions and Mitigative Measures

Permit conditions are imposed to avoid impacts from marina development. Any permit or certification can be conditioned by the approving agency. The conditions included in Table 6-14 are designed by the South Carolina Department of Health and Environmental Control (SCDHEC) to prevent degradation of existing water quality in order to meet the requirements for certification in accordance with Section 401 of the

TABLE 6-12

STATE OF SOUTH CAROLINA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classifications Potentially Impacted by Marina Siting			
Parameter	Class SAA[b]	Class SA[c]	Class SB[d]	Class SC[e]
Garbage, cinders, ashes, oils, sludge or other refuse	None allowed	None allowed	None allowed	None allowed
Treated wastes, thermal discharges, toxic wastes, deleterious substances, colored or other wastes	None allowed	None alone or in sufficient amounts to adversely affect the taste, color, odor or sanitary condition of clams, mussels or oysters for human consumption or to impair the waters for any other best usage	None alone or in combination with other substances or wastes in sufficient amounts to make the waters unsafe or unsuitable for primary contact recreation or impair waters for any other best usage	None alone or in combination with other substances in sufficient amounts to be harmful to survival of marine fauna or flora or culture/propagation thereof; to adversely affect taste, color, odor or sanitary condition of fish for human consumption; to make waters unsafe or unsuitable for secondary contact recreation or to impair waters for any other best usage
Disolved Oxygen	4 mg/l	> 5 mg/l (daily avg.) with a low of 4 mg/l. Some waters may have avg. of 4 mg/l due to natural conditions	Same as Class SA	> 3 mg/l

TABLE (2
(continued)
STATE OF SOUTH CAROLINA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

Parameter	Class SAA[b]	Class SA[c]	Class SB[d]	Class SC[e]
Organisms of Coliform gp	Not > MPN[f] total coliform median of 70/100 ml; not > 10% of samples exceed MPN of 230/100 ml (using 5 tube dilution method)	Same as Class SAA		
Fecal coliform			Not > geometric mean of 200/100 ml based on 5 consecutive samples during any 30-day pd.; not > 10% of samples in 30-day pd. exceed 400/100 ml	Not > geometric mean of 1000/100 ml based on 5 consec. samples during any 30-day pd; not > 2000/100 ml in more than 20% of samples during such pd
pH	Natural conditions	Not vary more than 0.3 of a pH unit above or below that of effluent-free waters in the same geological area with similar total salinity, alkalinity & temperature but between 6.5-8.5	Same as Class SA, but variance not more than 1 pH unit	Same but variance not more than 1 pH unit
Temperature	Existing levels under natural conditions	Not > weekly avg. temp. of 4°F (2.2°C) above temp. under nat. conditions during fall, winter or spring, or a weekly avg. of 1.5°F (0.8°C) during summer	Same as Class SA	Same as Class SA
Turbidity	Existing levels under natural conditions			

TABLE 6-12
(continued)
STATE OF SOUTH CAROLINA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

---

[a] South Carolina Department of Health and Environmental Control, 1981.

[b] Tidal salt waters which constitute an outstanding recreational or ecological resource and/or waters suitable for uses that require the absence of pollution. Suitable also for uses listed under footnotes c, d and e.

[c] Tidal salt waters suitable for harvesting clams, mussels or oysters, except within buffer zones. Suitable also for uses listed under footnotes d and e.

[d] Tidal salt waters suitable for primary contact recreation. Suitable also for uses listed under footnote e.

[e] Tidal salt waters suitable for secondary contact recreation, crabbing and fishing except harvesting clams, mussels or oysters for market purposes or human consumption. Also suitable for the survival and propagation of marine fauna and flora.

[f] MPN: Most Probable Number.

TABLE 6-13

STATE OF SOUTH CAROLINA

DREDGE AND SPOIL REQUIREMENTS[a]

- Dredging and filling in wetland areas shall be undertaken only if the proposed activity is water-dependent and there are no feasible alternatives
- To the maximum extent feasible, dredging and filling activities should be restricted in nursery areas and shellfish grounds and during critical periods in the life of important sport and commercial species
- Dredging and excavation shall not create stagnant water conditions, lethal fish entrapments, or deposit sumps or otherwise contribute to water quality degradation
- Designs for dredging and excavation projects shall, where feasible, include protective measures such as silt curtains, diapers, and weirs to protect water quality in adjacent areas during construction by preventing the dispersal of silt materials
- Dredged materials shall be deposited and contained in such a manner so as to prevent dispersal into adjacent wetland areas
- Upland disposal of dredged material is preferred; vegetated wetlands and mudflats shall not be utilized for disposal unless there are no feasible alternatives; any other wetlands should not be used for disposal when other alternatives exist
- Open and deep water sites should be considered for disposal if highland alternatives are not feasible only after consultation with the Council and other relevant state and federal agencies
- Existing disposal sites should be utilized to the fullest extent possible (where feasible)
- Dredged materials containing hazardous levels of toxic materials shall never be disposed of in wetland areas
- Dikes surrounding disposal areas should be shaped and vegetated immediately, with outfalls positioned to empty into non-wetland areas
- Attention must be given to possible adverse impacts of alternative deposition sites on public health and welfare
- In all cases, dredging activities shall not be approved until satisfactory disposal sites have been acquired.

---

[a] South Carolina Coastal Council, 1981.

TABLE 6-14

STATE OF SOUTH CAROLINA

EXAMPLES OF MARINA PERMIT CONDITIONS[a]

- Wastewater pumpout facilities are to be provided for boats using the marina. The facility is to be tied directly into the waste treatment system servicing the marina
- No persons shall live on boats moored at the marina unless the boats:
  - are equiped with Class 3 nondischarging marine sanitation devices
  - are hooked directly into the central sewer servicing the marina
  - use other wastewater collection or treatment systems approved by SCDHEC
- Specified water quality sampling program must be implemented
- The marina boat fueling system must be equipped with emergency pump cutoffs in the Harbor Master's facility and with manual cutoff valves at the tank, at the edge of the dock, and at the pump. Fuel lines from storage tanks to the pumps must be steel, preferably stainless steel. Fuel storage tanks are to be located below ground
- A copy of the Harbor Master's O & M manual is to be provided to DHEC for review and approval. It must contain procedures for containment of spills within the marina
- There are to be no discharges of fish processing wastes from onshore facilities or from boats docked at the marina. This includes trash fish, shrimp heads, and other waste normally thrown overboard during the cleaning and sorting of a catch
- There is to be no discharge of stormwater to the harbor
- The channel from the government-maintained turning basin to the marina basin shall be marked with appropriate markers at each bend so that boats will not stray from the channel into shallow water where they will churn up sediment.

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[a] South Carolina Department of Health and Environmental Control, 1981-1983.

Clean Water Act. If not met, certification will be suspended by the SCDHC. In turn, all other permits and licenses will be suspended. All conditions in Table 6-14 are actual conditions imposed on marina developers with 401 Certification. Additionally, SCDHEC closes an area within a 1000 ft radius of both ends of a marina or basin entrance channel to mitigate or eliminate possible bacterial contamination of shellfish due to marina activities.

In their proposed general policy concerning shellfish area closure due to marina siting and activities, the Marine Resources Division of the South Carolina Wildlife and Marine Resource Department recognizes that, because oysters and clams are a renewable resource, this characteristic should be the foundation for any type of mitigation arrangement.

Guidelines promulgated by SCDHEC also preclude the transplanting of an affected shellfish area (by a marina facility) to an unpolluted area. The reasons for this prohibition include:

- Existing oyster crops contribute greatly to substrate integrity and prevent erosion and siltation in the intertidal zone
- "Polluted" shellfish still filter polluted waters, contributing to the cleansing process by improving water quality in the closed area
- Although polluted for human consumption, these shellfish provide a healthy habitat to other estuarine organisms in the closed area
- Unnecessary mortalities of adult and juvenile oysters may occur during movement as well as potential damage to the underlying shell substrate. Additionally, it is probable that large numbers of larvae produced in the closed area will attach themselves to suitable substrates outside the affected area and eventually mature.

Summary of South Carolina Permit Process

A joint permit procedure has been implemented in South Carolina. Aside from a joint public notice requesting comments, there are totally separate comment review processes that proceed independently of each other following the joint notice.

The South Carolina Coastal Council and the Corps each review comments concerning the joint permit application. The Coastal Council also has permit responsibilities and issues or denies a separate state permit. The South Carolina Department of Health and Environmental Control is responsible for the State 401 Certification of the 404 Permit and conducts a separate 401 review. A separate, fast-track review process is available for 401 Certification. Both SCCC and SCDHEC have monitoring and enforcement authority and provide field representatives to assist permit applicants. The Corps' Section 404 regulations require that all federal, state or local certifications be obtained prior to Corps approval of a 404 Dredge and Fill Permit.

The USACOE, Charleston District Office requires submittal of a marina permit application. If the proposed project is in the Savannah River area, the application must be submitted to the Savannah District Office (See Appendix F, Georgia). The South Carolina Coastal Council (SCCC) receives a copy of the permit application from the Corps. SCCC, in turn, requests additional information from the applicant (See Appendix G). South Carolina Department of Health and Environmental Control (SCDHEC), Office of Environmental Quality Control receives a request for Section 401 water quality certification from the USACOE.

Following receipt of the completed application, the USACOE, SCCC and SCDHEC issue a Joint Public Notice, which serves as a means of notifying appropriate state and federal agencies who submit review comments on proposed projects. The state review agencies include: the Wildlife and Marine Resources Department, which evaluates impacts to shellfish and their habitat, and any other agency responsible for evaluating impacts to the cultural (particularly historical/archaeological resources) and the natural environment.

Typically, the USACOE reaches a permit decision within 60 days after receipt of the completed application. This can be extended if the nature of the proposed project requires a longer review period. The Coastal Council has a built-in period of 30 days while waiting for state agency comments. A decision on the permit is typically made 60 days after all comments are received (90 days after receipt of application). Delays may result if additional time is requested during state agency review or if a public hearing is requested. The Office of Environmental Quality Control, SCDHEC, generally forwards the 401 water quality certification to the applicant within 30 days following the request.

Although an application (obtained from USACOE) is required following site selection, both the USACOE and the SCCC (permit administrator) recommend a pre-application meeting between the applicant and the permittee to discuss the project prior to application submittal.

Georgia

Overall Permitting Program

The overall process for review of marina development proposals in Georgia is outlined in Figure 6-4. The regulatory program in Georgia is the Coastal Marshlands Protection Program, administered by the Coastal Marshlands Protection Commission (CMPC). Along with a permit from the CMPC, a marina developer must receive a 404 Corps Permit and a 401 Water Quality Certification, when required, from the Georgia Environmental Protection Division and a revokable license for use of state-owned lands.

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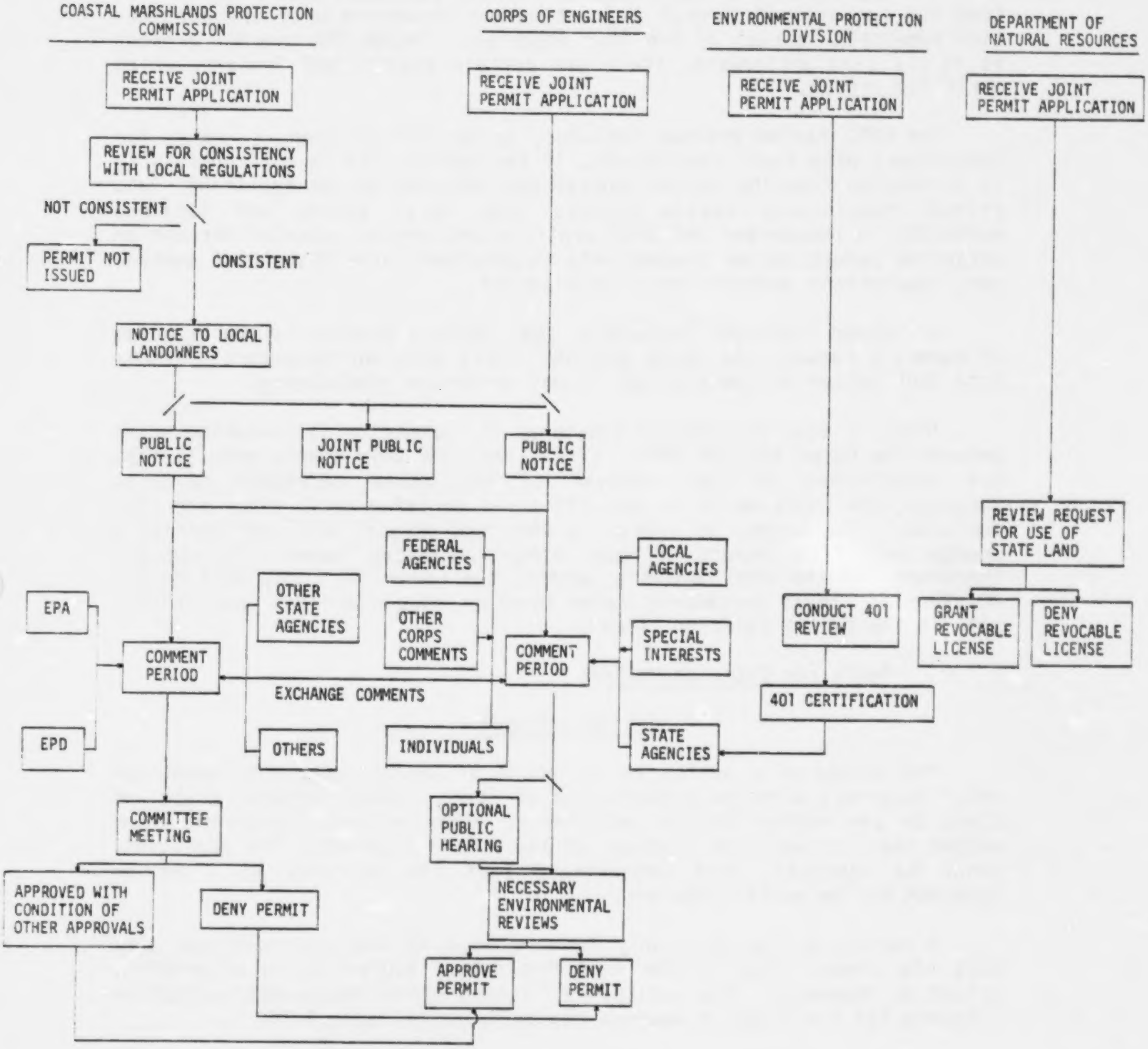
COASTAL MARSHLANDS PROTECTION COMMISSION
CORPS OF ENGINEERS
ENVIRONMENTAL PROTECTION DIVISION
DEPARTMENT OF NATURAL RESOURCES
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
REVIEW FOR CONSISTENCY WITH LOCAL REGULATIONS
NOT CONSISTENT
PERMIT NOT ISSUED
CONSISTENT
NOTICE TO LOCAL LANDOWNERS
PUBLIC NOTICE
JOINT PUBLIC NOTICE
PUBLIC NOTICE
REVIEW REQUEST FOR USE OF STATE LAND
FEDERAL AGENCIES
LOCAL AGENCIES
OTHER STATE AGENCIES
EPA
OTHER CORPS COMMENTS
CONDUCT 401 REVIEW
GRANT REVOCABLE LICENSE
DENY REVOCABLE LICENSE
COMMENT PERIOD
COMMENT PERIOD
SPECIAL INTERESTS
EXCHANGE COMMENTS
401 CERTIFICATION
EPD
OTHERS
INDIVIDUALS
STATE AGENCIES
COMMITTEE MEETING
OPTIONAL PUBLIC HEARING
APPROVED WITH CONDITION OF OTHER APPROVALS
DENY PERMIT
NECESSARY ENVIRONMENTAL REVIEWS
APPROVE PERMIT
DENY PERMIT

Figure 6-4. Georgia marina permitting process.

Although there are four separate reviews conducted (See Figure 6-4), they are coordinated through a joint permit procedure with one application submitted to each of the four agencies. Though the overall process is fairly straightforward, there are certain significant features which merit discussion.

The CMPC review process includes, as an initial step, a review for consistency with local regulations. If the application is not consistent, it is dropped from the review process and returned to the applicant. This initial consistency review assures that local zoning and land use authority is recognized and that applications are not carried through an extensive permit review process only to discover later that local government regulations prohibit their development.

A second important feature of the Georgia process is the exchange of comments between the Corps and CMPC. This does not necessarily eliminate duplication of comments but it may encourage consistency.

There is also an informal tie-in at the permit decision-making point between the Corps and the CMPC. First, the CMPC only grants permits that are conditioned on the approval of all other necessary permits. Secondly, the Corps waits to make its final decision until after the CMPC decision. The Corps, as stated in 404 regulations, will not approve a Dredge and Fill Permit if any other necessary permit is denied. Therefore, if the CMPC denies a permit, the Corps, in turn, will deny a 404 Permit. These procedures taken together should provide some uniformity in the permit decision process.

Basis for Decision-Making

Siting Criteria

The siting of a marina in the State of Georgia must not "unreasonably" interfere with the conservation of fish, shrimp, oysters, crabs and clams or any marine life or wildlife or other natural resources to the extent that it would be contrary to the public interest. The applicant, prior to approval, must demonstrate that the activity will not be contrary to the public interest.

A marina siting will only be permitted if the applicant can show that the chosen site is the most feasible, insofar as no alternative upland or deepwater site exists. A listing of marina permit evaluation criteria for the State of Georgia can be found in Table 6-15.

Water Quality Criteria

Water quality criteria applicable to marina siting areas are presented in Table 6-16. These criteria include those parameters that may be negatively impacted by marina construction and/or use. Parameters such as fecal coliform, pH and temperature could be affected by the use of marine sanitation devices on boats in the marina. Toxic wastes such as

TABLE 6-15

STATE OF GEORGIA

MARINA PERMIT EVALUATION CRITERIA[a]

- No unreasonably harmful obstruction to or alteration of the natural flow of navigational water should arise, and need for maintenance dredging should be minimal
- No unreasonably harmful or increased erosion, shoaling of channels, nor stagnant areas of water should be created to such an extent as to be contrary to the public interest
- Project will not unreasonably interfere with the conservation of fish, shrimp, oysters, crabs, and clams or any marine life or other natural resources to such an extent as to be contrary to the public interest
- Public demand must justify alteration of marshlands
- If dredging is involved, proposal must include a description of the type, composition and quantity of the material to be dredged, the method of dredging and site of and plans for disposal of dredged material
- Only those marine-oriented activities and structures which must have a shoreline or marshlands location in order to function will be considered
- Amount of marshlands to be altered should be minimum in size
- Marinas will be considered only if no alternative upland or deepwater site is feasible
- Designs should adequately serve needs of commercial and sports fisheries and other water recreation as well as other demonstrated public needs
- Water supply and waste disposal facilities must be approved by the Environmental Protection Division, Department of Natural Resources, prior to approval
- Proposal must provide for public safety and access and minimize the possibility of fuel spills.

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[a] Rules of the Georgia Department of Natural Resources, 1975.

TABLE 6-16

STATE OF GEORGIA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classifications Potentially Impacted by Marina Siting	
Parameter	Recreation[b]	Fishing[c]
Bacteria: Fecal Coliform	Not > geometric mean of -100/100 ml; based on 4 or more samples over a 30-day pd. at intervals not > 24-hr	Not > geometric mean of 1000/100 ml, based on 4 or more samples over a 30-day pd. and not > mas.: 4000/100 ml[d]
pH	6.0-8.5	6.0-8.5
Temperature	Not > 90°F. Receiving water temperature not to be increased by more than 1.5°F	Same as recreation
Toxic Wastes	None in concentrations that would harm man, fish and game or other beneficial aquatic life	Same

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[a] Georgia Department of Natural Resources, 1980.

[b] Includes general recreational activities, i.e., water skiing, boating and swimming, etc.

[c] Propagation of fish, shellfish, game and other aquatic life...

[d] Applicable to waters designated as shellfish harvesting waters: requirements for bacteria will be consistent with those established by state and federal agencies responsible for the National Shellfish Sanitation Program.

oils may be inadvertantly spilled into waters during construction operations or during boat refueling operations or repair.

The evaluation criteria in Table 6-15 support the preservation of existing water quality through requirements that waste disposal facilities be approved by the Environmental Protection Division of the Georgia Department of Natural Resources prior to marina permit approval and that the activity be designed so that the possibility of fuel spills is minimized. The 401 Water Quality Certification required from the Georgia Environmental Protection Division is applicable during dredging and filling and throughout the operation of the facility.

Dredge and Fill Requirements

Dredge and fill requirements are found in Table 6-17. Generally, if dredging is required, the applicant must describe the material to be dredged, the dredging method and must submit plans for spoil disposal, particularly disposal sites as part of the marina permit application. In most cases, upland sites for disposal of dredge spoil will be required.

Both initial and maintenance dredging must be timed and located such that movements and lifestages of fish, shellfish and wildlife are protected, particularly during spawning and early development. Overall, the design of the marina should be such that both initial and maintenance dredging is minimal.

Permit Conditions and Mitigative Measures

Table 6-18 presents eight examples of actual conditions imposed by the CMPC on approved marina applications. If the condition or conditions are not met, permit approval may be revoked. Most of the conditions in Table 6-18 are designed to mitigate any potential impact to the natural environment including marine life and wildlife, vegetation and water quality in all areas that may be adversely impacted by dredging, by marina construction activities and marina use.

Summary of Georgia Permit Process

In terms of overall approach, Georgia is fairly typical of states with joint permit procedures. This program requires a license to use state lands and certain features of the permitting procedure encourage consistency with local and federal decision-making. Field representatives are available to assist the applicant.

In Georgia, marina development requires a Coastal Marshland Protection Permit from the Department of Natural Resources (DNR), Coastal Resources Division. A copy of the joint application for the USACOE permit, the Marshland Protection Permit and Water Quality Certification (if needed) is included in Appendix G. The application provides explicit direction on the type of supporting information required and where to forward the completed application. In addition, a detailed list of joint

TABLE 6-17

STATE OF GEORGIA
DREDGING REQUIREMENTS[a]

- The design and alignment of navigation channels, canals, or ditches should meet demonstrated public needs, insure adequate flushing, and make maximum use of natural and existing deepwater channels. Projects should not create stagnant pockets of water or increase shoreline erosion
- Plans of channel dredging should be designed to avoid siltation at the point where the dredged channel joins with the natural channels and the marshlands. Sumps should be constructed to contain silt prior to the introduction of an upland channel into marshlands
- Plans for channel and ditch construction should include appropriate methods for spoil disposal. In most cases upland disposal of dredge spoil (with adequate protection against runoff) will be required
- Whenever possible, project plans should utilize piers or docks rather than channels or canals to reach deeper waters
- The timing and location of dredging activities should take into consideration the movements and lifestages of fish, shellfish, and wildlife, especially during spawning and early development

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[a] Georgia Department of Natural Resources, 1975.

TABLE 6-18

STATE OF GEORGIA

EXAMPLES OF MARINA PERMIT CONDITIONS[a]

- That all small boat storage facilities be moved to the existing upland and none be placed on the filled marsh
- That the project is to comply with all other federal, state and local statutes, ordinances, and regulations, and the applicant is to obtain all licenses and permits prior to commencement of construction
- That certain items or structures be moved to the upland
- That the dredged material disposal site be legally bound in perpetuity for maintenance dredged material, and that the site be designated by maps and plans
- That sumps be placed at the weir outfalls to prevent siltation of marsh
- That the fixed dock be moved channelward... to reduce dredging of marsh to a minimum
- That bank stabilization with rip-rap be restricted to those areas too unstable for native vegetation
- That equipment utilized in the marsh for pier construction be placed on mats, and not on fill material.

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[a] Georgia Department of Natural Resources, 1983.

application procedures and a sample copy of the form letter to DNR's Executive Assistant requesting a revocable license for use of state land are included. These documents are all included as part of the application package which can be obtained by contacting either the USACOE Savannah Office or DNR and asking for the "Permit Packet."

The USACOE, Savannah District, DNR's Coastal Resources Division (CRD) and Environmental Protection Division (EPD) and the Executive Department all receive copies of the marina permit application along with the supporting information. Other state and federal agencies are notified of the proposed project and comments are solicited through the Joint Public Notice issued by the USACOE and the CRD.

The USACOE's goal is to reach a permit decision within 60 days, however, the nature of the project may require a longer review period. The Coastal Resources Division also makes a decision within 60 days after receipt of a completed application. The permit decision also may be delayed depending upon the nature and extent of agency review. Although applications must be submitted following site selection, both the USACOE and the CRD recommend a pre-application meeting to discuss the proposed project. The EPD and the Executive Department each notify the applicant of their decisions on the 401 water quality certification and the request for use of state-owned lands, respectively.

Florida

Overall Permitting Program

The permitting procedure for marina development in Florida is, by far, the most complex of the six states. The primary state review for marinas is through the state dredge and fill program, administered by the Department of Environmental Regulation (DER). The dredge and fill program is authorized under two separate pieces of legislation, one applied to all waters and one only to navigable waters. Each has its own review procedures. The review and 401 Certification process is integrated into the dredge and fill programs.

The Florida Department of Community Affairs administers a state program for reviewing developments of regional impact (DRI), including marinas. Under this program, an activity found to be a DRI must receive a state review and approval in addition to meeting local regulations. Figure 6-5 outlines the process for determining if a proposed project is a DRI. Once this determination has been made, a separate review procedure is carried out. Although a number of specific factors are considered in evaluating marinas, the key criteria is the number of slips. Marinas with 100 or more slips are typically determined to be DRIs.

Although the overall program in Florida is quite complex, the use of a joint process has added a degree of coordination. One permit application is prepared and the DER forwards copies to the Corps and DNR. DER then determines if the project can be exempt. If not, DER decides if

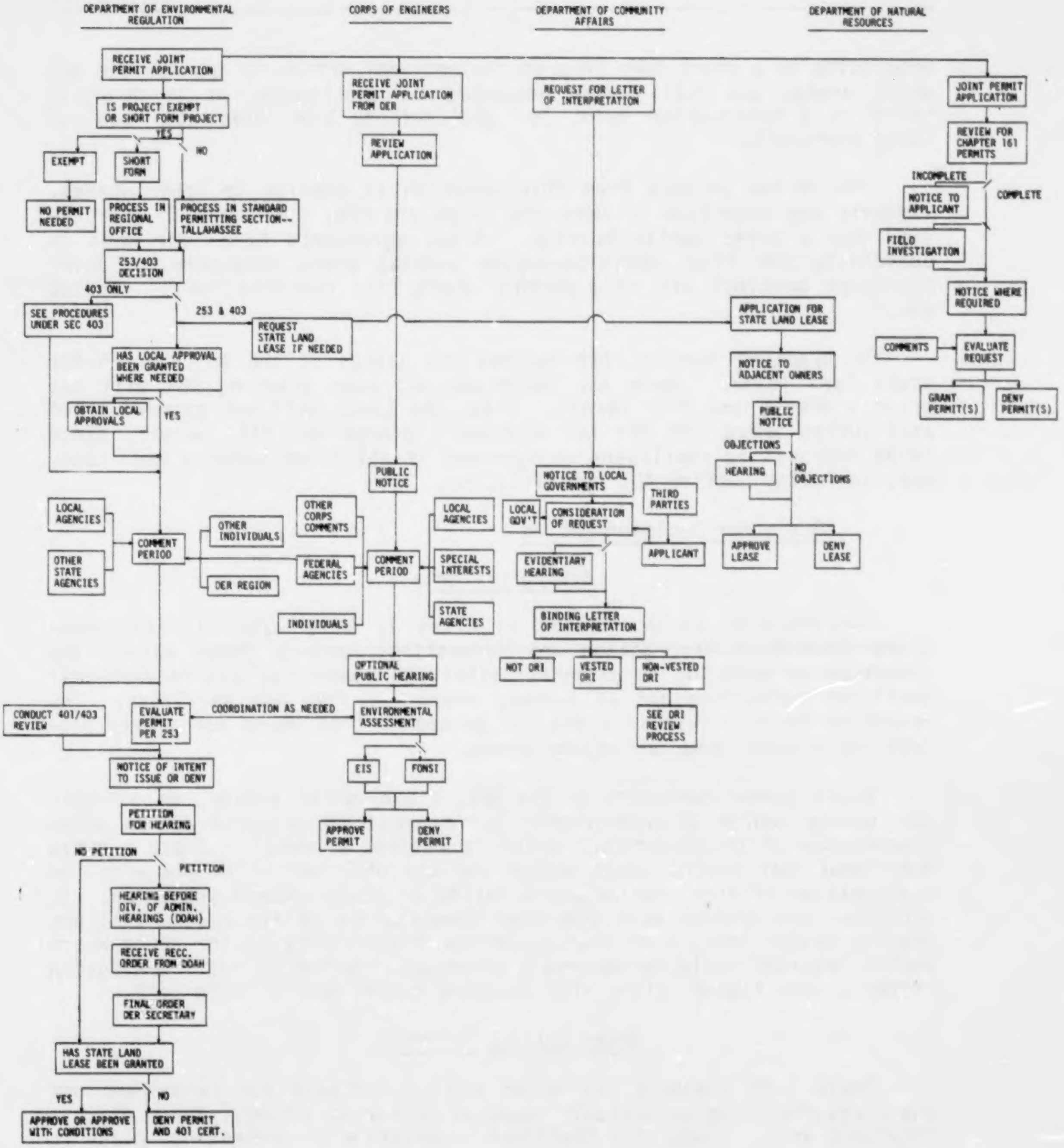
DEPARTMENT OF ENVIRONMENTAL REGULATION
CORPS OF ENGINEERS
DEPARTMENT OF COMMUNITY AFFAIRS
DEPARTMENT OF NATURAL RESOURCES
RECEIVE JOINT PERMIT APPLICATION
IS PROJECT EXEMPT OR SHORT FORM PROJECT
YES
NO
EXEMPT
SHORT FORM
NO PERMIT NEEDED
PROCESS IN REGIONAL OFFICE
PROCESS IN STANDARD PERMITTING SECTION--TALLAHASSEE
253/403 DECISION
403 ONLY
SEE PROCEDURES UNDER SEC 403
253 & 403
REQUEST STATE LAND LEASE IF NEEDED
HAS LOCAL APPROVAL BEEN GRANTED WHERE NEEDED
OBTAIN LOCAL APPROVALS
YES
LOCAL AGENCIES
OTHER STATE AGENCIES
COMMENT PERIOD
OTHER INDIVIDUALS
DER REGION
CONDUCT 401/403 REVIEW
EVALUATE PERMIT PER 253
COORDINATION AS NEEDED
NOTICE OF INTENT TO ISSUE OR DENY
PETITION FOR HEARING
NO PETITION
PETITION
HEARING BEFORE DIV. OF ADMIN. HEARINGS (DOAH)
RECEIVE RECC. ORDER FROM DOAH
FINAL ORDER DER SECRETARY
HAS STATE LAND LEASE BEEN GRANTED
YES
NO
APPROVE OR APPROVE WITH CONDITIONS
DENY PERMIT AND 401 CERT.
RECEIVE JOINT PERMIT APPLICATION FROM DER
REVIEW APPLICATION
PUBLIC NOTICE
OTHER CORPS COMMENTS
FEDERAL AGENCIES
INDIVIDUALS
COMMENT PERIOD
LOCAL AGENCIES
SPECIAL INTERESTS
STATE AGENCIES
OPTIONAL PUBLIC HEARING
ENVIRONMENTAL ASSESSMENT
EIS
FONSI
APPROVE PERMIT
DENY PERMIT
REQUEST FOR LETTER OF INTERPRETATION
NOTICE TO LOCAL GOVERNMENTS
LOCAL GOV'T
CONSIDERATION OF REQUEST
THIRD PARTIES
APPLICANT
EVIDENTIARY HEARING
BINDING LETTER OF INTERPRETATION
NOT DRI
VESTED DRI
NON-VESTED DRI
SEE DRI REVIEW PROCESS
APPLICATION FOR STATE LAND LEASE
NOTICE TO ADJACENT OWNERS
PUBLIC NOTICE
OBJECTIONS
HEARING
NO OBJECTIONS
APPROVE LEASE
DENY LEASE
JOINT PERMIT APPLICATION
REVIEW FOR CHAPTER 161 PERMITS
INCOMPLETE
COMPLETE
NOTICE TO APPLICANT
FIELD INVESTIGATION
NOTICE WHERE REQUIRED
COMMENTS
EVALUATE REQUEST
GRANT PERMIT(S)
DENY PERMIT(S)

Figure 6-5. Florida marina permitting process.

processing on a short form through the regional office is appropriate and which dredge and fill review procedure is applicable. As in Georgia, there is a termination point for applications that have not received local approvals.

The review process from this point on is similar to other states. Comments are submitted to both the Corps and DER, but there is a provision for a joint public hearing. Also, agreements have been made to coordinate the final decision-making process where necessary. Joint DER/Corps meetings are held monthly where this coordination is carried out.

In granting permits, DER reviews the status of the application for state land lease. Where the lease has not been granted, DER will not grant a dredge and fill permit. Also, the Corps will not approve a 404 application where DER did not approve a dredge and fill permit, since Corps approval is contingent on approval of all other permits and licenses, including Section 401 Certification.

Basis for Decision-Making

Siting Criteria

Construction is prohibited in Class II Water Use Classification Areas (Shellfish Propagation and Harvesting) because these waters are important as existing or potential sites for commercial and recreational shellfish harvesting and as nursery areas for fish and shellfish. The exception to this rule is a plan or procedure that would adequately protect the project area and nearby areas.

Where deemed necessary by the DER, a biological survey, an ecological survey and/or a hydrographic survey must be prepared by or under supervision of the Department prior to project approval. These surveys must show that marina construction and use will not interfere with the conservation of fish, marine and wildlife or other natural resources. In addition, the studies must show that construction of the marina will not destroy oyster beds, clam beds or marine productivity to the point where public interest would be adversely affected. Marina permit evaluation criteria are listed along with dredging guidelines in Table 6-19.

Water Quality Criteria

Table 6-20 presents DER water quality criteria for parameters and use classifications potentially impacted by marina siting. These classifications are: Class II - Shellfish Propagation or Harvesting; Class II - Recreation - propagation and maintenance of a healthy, well population of fish and wildlife; and Class V - Navigation, Utility and Industrial Use. These water quality standards and use classifications relate to the effects of changes in heavy metal concentrations, bacteriological quality, dissolved oxygen, nutrient levels, odor and pH. These changes can occur as a result of boat maintenance, fueling, discharges from MSDs, dredging, construction, and dumping of fish wastes or other refuse.

TABLE 6-19

STATE OF FLORIDA

MARINA PERMIT EVALUATION CRITERIA AND DREDGE AND SPOIL REQUIREMENTS[a]

The Department may require the preparation of biological and/or hydrographic surveys. These survey(s), prepared by or under the supervision of the Department, are to contain findings and recommendations with reference to the effects of the proposed activity upon fish, wildlife and other natural resources

These surveys must show that:

- project activities will not interfere with the conservation of fish, marine and wildlife or other natural resources, to such an extent as to be contrary to the public interest. Activities will not destroy oyster beds, clam beds, or marine productivity. This includes, but is not limited to, destruction of natural marine habitats, grass flats suitable as nursery or feeding grounds for marine life. Established marine soils suitable for producing plant growth of a type useful as nursery or feeding grounds for marine life or natural shoreline processes shall not be interferred with to such an extent as to be contrary to the public interest

- the proposed project will not create a navigational hazard, or a serious impediment to navigation, or substantially alter or impede the natural flow of navigable waters, so as to be contrary to the public interest

All dredge and fill activities shall comply with state water quality standards

Applicant shall provide reasonable assurance that the short-term and long-term effects of the marine activity will not result in violation of state water quality standards

Permits for construction in Class II areas (due to importance as existing or potential sites of commercial and recreational shellfish harvesting and as a nursery area for fish and shellfish) will be denied, except for those plans and procedures which will adequately protect the project area and nearby areas

If the project involves the state transportation system, it must be certified by the Florida Department of Transportation (DOT).

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[a] Florida Department of Environmental Regulation, 1983.

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TABLE 6-20

STATE OF FLORIDA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classifications Potentially Impacted by Marina Siting		
Parameter	Class II[b]	Class I[c]	Class V[d]
Aluminum	1.5 mg/l	1.5 mg/l	
Antimony	0.2 mg/l	0.2 mg/l	
Bacteriological Quality	Median coliform MPN-70/100ml 10% of samples MPN-230/100ml Fecal coliform bacterial level-median of 14 MPN/100ml 10% of samples MPN-43/100ml	Fecal coliform bacteria-monthly avg.-200/100ml; 10% of samples-400/100ml 800/100ml-daily; Total coliform count 1000/100ml-monthly average; 1,000/100ml 20% of samples/month; 2,400/100ml at any time.	
Biological Integrity	Shannon-Weaver index of benthic macroinvertebrates-not less than 75% of est. background levels as measured using a U.S. Stnd.#30 sieve; collected & composited from a min. of 3 natural substrate samples, taken with Ponar type samplers with min. sampling areas of 225 sq. cent.	Same as Class II	
Bromine & Bromates	Free bromine - 0.1 mg/l; bromates - 100 mg/l	Free bromine - 0.1 mg/l Bromates - 100 mg/l	
Cadmium	5.0 micrograms/l	5.0 micrograms/l	
Chlorine	0.01 mg/l	0.01 mg/l	
Copper	0.015 mg/l	0.015 mg/l	
Cyanide	5.0 micrograms/l	5.0 micrograms/l	5.0 micrograms/l
DO	Avg. - 4 mg/l/24 hr.pd. 3 mg/l always	Same as Class II	> 1.0 mg/l
Fluorides	1.5 mg/l	5.0 mg/l	
Iron	0.3 mg/l	0.3 mg/l	
Manganese	0.1 mg/l		
Mercury	0.1 micrograms/l	0.1 micrograms/l	0.2 micrograms/l
Nickel	0.1 mg/l	0.1 mg/l	

TABLE 6-20
(continued)
STATE OF FLORIDA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

Parameter	Class II[b]	Class I[c]	Class V[d]
Nutrients	In no case shall nutrient concentrations be altered so as to cause an imbalance in nat. pop. of aquatic flora or fauna	Same as Class II	
Odor	Threshold: 24@60°C as a daily average		Only in such amts. as will not unreasonably interfere with use of the water for its intended purpose
pH	No more than one unit above or below nat. background of coastal waters, provided it is between 6.5-8.5. If nat. background < 6.5, pH shall not vary below nat. background or more than one unit above. If > 8.5, pH shall not vary above nat. background or more than one unit below	Same as Class II	5.0-9.5, except certain swamp waters which may be as low as 4.5
Phosphorus (elemental)	0.1 micrograms/l	0.1 micrograms/l	
Polychlorinated Biphenyls (PCB's)	0.001 micrograms/l	0.001 micrograms/l	
Selenium	0.025 mg/l	0.025 mg/l	
Silver	0.05 micrograms/l	0.05 micrograms/l	
Total Dissolved Gases	110% or less of saturation value for gases @ existing atmospheric & hydrostatic pressures	Same as Class II	
Transparency	Depth of compensation point for photosynthetic activity shall not be reduced by more than 10% as compared to nat. background value	Same as Class II	

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[a] Florida Department of Environmental Regulation, 1983.

[b] Shellfish Propagation or Harvesting.

[c] Recreation-propagation and maintenance of a healthy, well balanced population of fish and wildlife.

[d] Navigation, utility and industrial use.

The Marina Permit Evaluation Criteria in Table 6-19 state that an applicant must provide reasonable assurance that the short-term and long-term effects of the proposed activity will not violate state water quality standards set forth in Chapter 17-3 of the Florida Administrative Code (F.A.C.). Section 401 of the Clean Water Act requires an applicant to receive certification that discharge into the waters of the United States will comply with applicable effluent limitations and water quality standards. This certification pertains to both construction activities and subsequent facility operation.

Dredge and Fill Requirements

Dredge and fill requirements for the state of Florida are listed in Table 6-19. These requirements state that marina construction activity must not, at any time, violate state water quality standards. Additionally, a biological hydrographic survey of the potentially affected area is required prior to any construction.

Permit Conditions and Mitigative Measures

Permit conditions and mitigative measures imposed on applicants by state agencies for the purpose of eliminating or lessening the environmental impact of a proposed action are found in Table 6-21. These include restricting the depth of boat basins to a specific depth below mean low water to provide adequate light penetration and circulation for marine organisms, placing rubble rip-rap to provide additional habitat for marine organisms, and taking steps to prevent pollution from entering waterways.

Summary of Florida Permit Process

The Florida permitting program is complex. Features have been adopted that achieve some coordination between DER and local governments, the Corps and DNR. However, there is currently no coordination between DER and the DRI program or the coastal zone regulatory programs under DNR. Applicants are provided with a permitting booklet and checklist. DER provides field representatives and both DER and DNR assign one point of contact for each permit.

The Florida Department of Environmental Regulation (DER) requires the submittal of a marina permit application and supporting material, including an affidavit of ownership and drawings sealed by an engineer (See Appendix G). If the permit is approved, DER will also issue the 401 water quality certification. The DER forwards copies of the application to the USACOE, Jacksonville District for review and also to the Department of Natural Resources (DNR), which works directly with the applicant to issue a state submerged lands lease.

TABLE 6-21

STATE OF FLORIDA

EXAMPLES OF MARINA PERMIT CONDITIONS[a]

- Limit boat basin expansion to a depth of -5 feet mean low water[b]
- Place rubble rip-rap at toe of all new bulkhead construction to provide additional habitat for marine organisms[b]
- Take positive steps to minimize the introduction of organics or other pollutants into the waterway (e.g., through a mangrove leaf barrier)[c]
- Realign the proposed marina to make maximum use of the prevailing wind's ability to flush surface debris from the waterways[c]
- Recommend spoil be hauled to an upland site to prevent the possibility of its entering the water[d]
- Recommend silt screens be used across the marina entrance to prevent siltation in adjoining waters[d].

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[a] Maloney et al., 1980.

[b] Florida Game and Fresh Water Fish Commission, 1974.

[c] Florida Game and Fresh Water Fish Commission, 1975.

[d] Florida Department of Environmental Regulation, 1977.

DER also solicits comments from state agencies. The Game and Fresh Water Fish Commission, Regional Planning Districts and the State Historic Preservation Officer are asked to comment on the project from their regulatory perspectives. These agencies have 30 days to respond unless an extension is granted. Comments from other agencies are requested when appropriate. DNR evaluates the application if the proposed site is in an established aquatic preserve area or if oyster or shellfish producing areas may be impacted. The USACOE solicits comments from other federal agencies through their Public Notice process.

Typically, the USACOE's goal is to reach a permit decision in 60 days, although agency backlog or review period extensions may prolong the time frame. DER's decision is generally made 90 days following receipt of the completed application; they may take an additional 30 days after receipt of the application to request additional information from the applicant.

An application must be submitted following site selection, although both the USACOE and DER encourage a pre-application meeting to discuss the project.

In addition to issuing the state submerged lands lease, which must be obtained before a permit can be granted, DNR also reviews the project for a beaches and shores permit when any structure is proposed for a sandy beach area.

A sample copy of the USACOE and DER's joint application form is included in Appendix G. The application form is available from either the USACOE or from DER's main office or any branch office.

Alabama

Overall Permitting Program

Alabama is the one coastal state in USEPA Region IV that does not operate a separate state regulatory program to control marina development. The approach taken by Alabama is to review the proposed development activity for consistency with the state Coastal Zone Management Plan. The consistency finding then becomes binding on the Corps decision on the application for a 404 Permit. The overall permit review process is illustrated in Figure 6-6.

To develop a coastal marina in Alabama, the first step is to submit an application to the Corps of Engineers. The Corps issues a public notice on the project and proceeds with a standard review process. At the same time, the Alabama Department of Environmental Management (DEM) receives an information copy of the permit. Where required, DEM also receives a request from the Corps for a 401 Certification. Although DEM does not administer a specific marina permitting program, there are coastal use policies and regulations contained in the Coastal Zone Management Plan. DEM reviews the Corps application based on these cri-

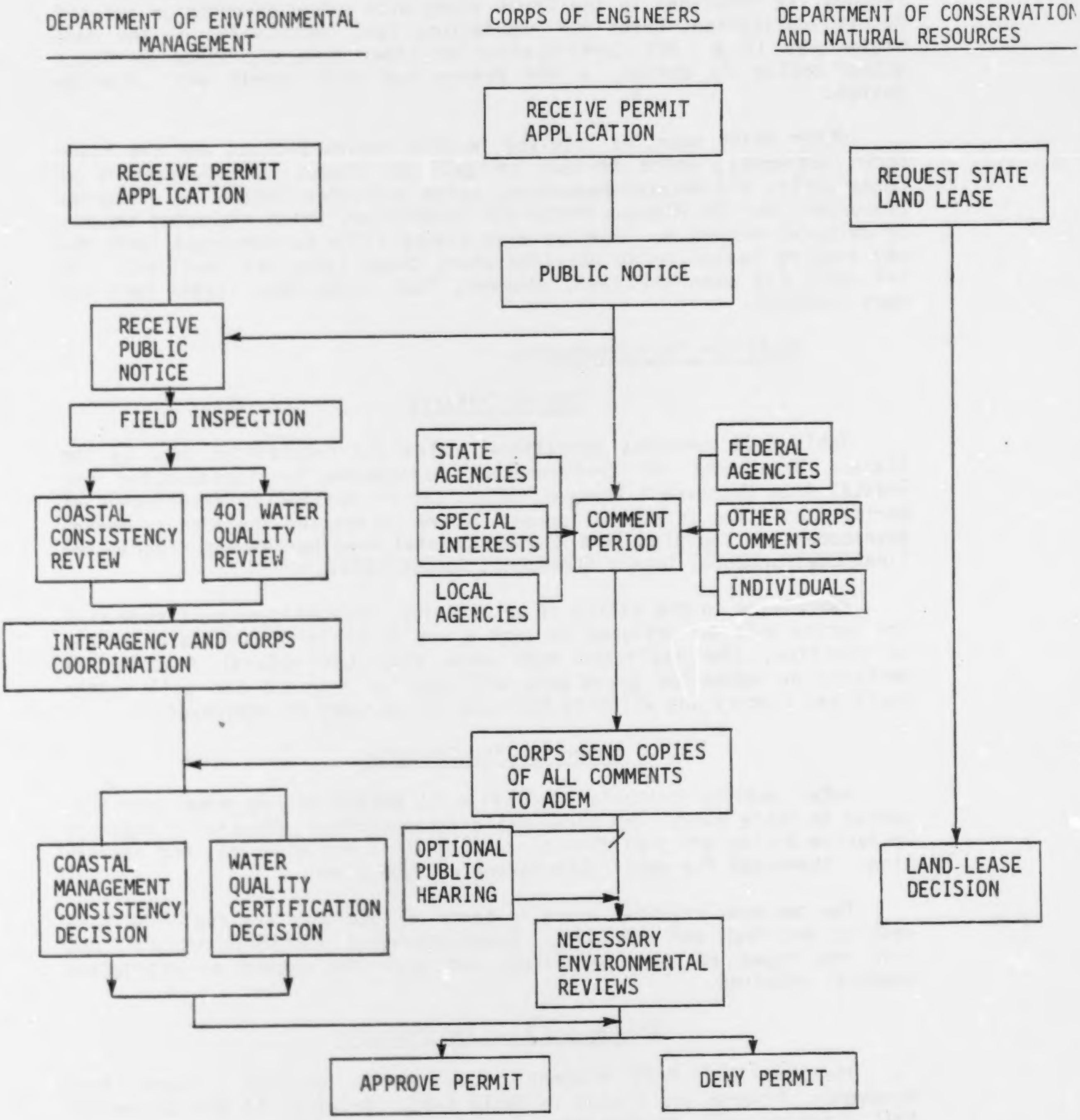
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
CORPS OF ENGINEERS
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
RECEIVE PERMIT APPLICATION
RECEIVE PERMIT APPLICATION
REQUEST STATE LAND LEASE
PUBLIC NOTICE
RECEIVE PUBLIC NOTICE
FIELD INSPECTION
STATE AGENCIES
FEDERAL AGENCIES
COASTAL CONSISTENCY REVIEW
401 WATER QUALITY REVIEW
SPECIAL INTERESTS
COMMENT PERIOD
OTHER CORPS COMMENTS
LOCAL AGENCIES
INDIVIDUALS
INTERAGENCY AND CORPS COORDINATION
CORPS SEND COPIES OF ALL COMMENTS TO ADEM
COASTAL MANAGEMENT CONSISTENCY DECISION
WATER QUALITY CERTIFICATION DECISION
OPTIONAL PUBLIC HEARING
LAND-LEASE DECISION
NECESSARY ENVIRONMENTAL REVIEWS
APPROVE PERMIT
DENY PERMIT

Figure 6-6. Alabama marina permitting process.

teria in order to make a consistency determination. The decision, once reached, is forwarded to the Corps along with other comments on the 404 Permit application. Corps 404 regulations (and Section 401 of the CWA) state that if a 401 Certification or other federal, state or local authorization is denied, a 404 Dredge and Fill Permit will also be denied.

Other state agencies involved in this review process are the State Docks Authority, which reviews navigational issues, the Department of Conservation and Natural Resources, which evaluates impacts on fisheries resources, and the Alabama Historical Commission, which evaluates impacts on cultural resources. Alabama also claims title to submerged lands and may require leases to be obtained where these lands are involved. It has generally been the case, however, that state land leases have not been required.

Basis for Decision-Making

Siting Criteria

Table 6-22 presents operational rules and regulations used by the Alabama Department of Environmental Management in implementing the Coastal Area Management Program, which can be applied to development of marina facilities in coastal zones. There is nothing specific to marina development in the plan (The Alabama Coastal Area Management Program and Final Environmental Impact Statement, August 1979).

Pertaining to the siting of an activity, an applicant must show that the marina will be designed in such a way to minimize hurricane damage. In addition, the applicant must show that the natural function of wetlands or submerged grasslands will not be degraded nor will oyster reefs and fishery and wildlife habitats be degraded or destroyed.

Water Quality Criteria

Water quality criteria applicable to marina siting areas are presented in Table 6-23. The three use classifications potentially impacted by marina siting are shellfish harvesting, fish and wildlife, and navigation. Standards for applicable parameters are given.

The two most critical areas in terms of standards are shellfish harvesting and fish and wildlife. These stringent standards dictate, not only the types of uses permitted, but also the extent of mitigative measures required.

Dredge and Fill Requirements

Dredging and fill disposal requirements of the Alabama Area Management Program are listed in Table 6-24. Briefly, if DEM determines that dredging will degrade the coastal area it will not be permitted. Channel construction or maintenance to existing or approved marinas will

TABLE 6-22

STATE OF ALABAMA

CRITERIA FOR SITING OF ACTIVITIES IN THE COASTAL AREA[a]

- Development shall be designed, located, constructed and operated in a manner that will not significantly increase potential damage resulting from a hurricane
- No solid waste disposal sites will be located in wetlands or on beaches or dunes
- Applicant must submit erosion control plan
- Proposed activity must not degrade any natural function of wetlands or submerged grasslands including the ability to support present levels of plants and animals and act as a buffer against storm surges or any other natural function
- Development must not degrade oyster reefs or fishery habitats
- Development must preserve and protect existing wildlife and wildlife habitats.

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[a] USDOC, 1979.

TABLE 6-23

STATE OF ALABAMA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classifications Potentially Impacted by Marina Siting		
Parameter	Shellfish Harvesting [b]	Fish & Wildlife[c]	Navigation[d]
pH	6.5-8.5 or not greater than 1 unit from the normal or natural value of the water body	Same as shellfish harvesting	Same as shellfish harvesting
Temperature	Addition of artificial heat shall not exceed 4°F (Oct-May) or 1°F (June-Sept); maintain normal daily & seasonal variations; no thermal block to aquatic organism migration	Same	
Dissolved Oxygen	Estuaries, tidal tributaries & coastal: not < 5mg/l except as caused by natural phenomena	Same	Not < 2.0 ppm
Toxic Substances (attributable to sewage, industrial wastes or other wastes)	Not injurious to fish & aquatic life; should not affect marketability of fish & shellfish; should not exceed 1/10 of 96-hr. median tolerance limit, fish, aquatic life or shellfish	Same	
Color, Taste & Odor (attributable to sewage, industrial wastes or other wastes	Not injurious to fish & aquatic life; should not affect marketability of fish & shellfish; not unreasonably affect aesthetic value for any use in this classification	Same	
Bacteria	Not to exceed limits in National Shellfish Sanitation Program Manual of Operations, Sanitation of Shellfish Growing Areas by USEPA	Fecal coliform: not > geometric mean of 1,000/100ml on a monthly avg. value; nor max. of 2,000/100ml in any sample	

TABLE 6-23

(continued)

STATE OF ALABAMA
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

Parameter	Shellfish Harvesting[b]	Fish & Wildlife[c]	Navigation[d]
Turbidity	None, except natural origin causing substantial visible contrast with natural appearance or interfering with use; not > 50 Nephelometric units above background	Same	Same

[a] Alabama Water Improvement Commission, 1982.

[b] Propagation & harvesting of shellfish for sale or use as a food product.

[c] Fishing, propagation of fish, aquatic life, & wildlife, and any other usage except water-contact sports, water supply source for drinking or food-processing purposes.

[d] Navigation & related activities.

TABLE 6-24

STATE OF ALABAMA

DREDGE AND FILL REQUIREMENTS[a]

- Dredging and filling operations shall not be permitted if it is determined by ADEM to degrade the coastal area
- New dead end canals shall not be permitted unless ADEM determines that such activity will not degrade the coastal area
- Proposed channel construction or channel maintenance providing access to existing or approved marinas shall be permitted only if there are no other reasonable means of access to such facilities
- Dredge spoil materials shall be deposited in upland areas or in offshore Gulf of Mexico areas unless it is determined by ADEM that the dredge spoil material may be used in another manner that will not degrade the coastal area
- No dredge spoil, fill or other foreign solid materials shall be deposited in waters of the coastal area unless it is determined by ADEM that such deposition will not degrade the coastal area
- Normal maintenance dredging of existing channels is permitted if the dredging operation maintains the channel within the original design specifications.

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[a] USDOC, 1979.

be approved only following determination by DEM that there is no other reasonable means of access.

Fill may be disposed of only in upland areas or in offshore Gulf of Mexico areas. However, if DEM determines that the fill material can be deposited in the coastal area and not degrade the waters, then such deposition may take place.

Permit Conditions and Mitigative Measures

Examples of marina permit conditions and possible mitigative measures imposed on applicants by DEM are found in Table 6-25. A condition or mitigative measure is attached to a permit application following review and is a restriction intended to eliminate or lessen unavoidable adverse impacts of marina construction or use. The Corps also conditions a 404 Permit to assure water quality maintenance and consistency with the state's Coastal Area Management Program (agreement between Alabama DER and USCOE, 1983). Such conditions or measures can include elevating everything on piers, restoring or revegetating wetlands, and not infringing on oyster beds, submerged grass beds or fish reefs as ways of protecting the natural environment. Non-structural methods of protecting coastal areas from potential damage following construction are generally recommended.

The water quality certification pursuant to Section 401 of the CWA is designed to protect the quality of the affected water body for its intended use. This certification is applicable throughout both construction and facility operation.

Summary of Alabama Permit Process

The overall marina permitting process in Alabama is straightforward and uncomplicated. There is no duplication of comments and only one final approval is required. Although the state has opted not to directly control marina development, it still has effective control through the Alabama Coastal Area Management Plan. This consistency review provides an element of regional planning in marina siting decisions.

Alabama has no specific marina criteria for evaluating permit applications. The State relies on standards for components of marina development such as dredging and filling in order to evaluate permits. Field services personnel assist the applicant and carry out monitoring activities.

TABLE 6-25

STATE OF ALABAMA

EXAMPLES OF MARINA PERMIT CONDITIONS AND MITIGATION MEASURES[a]

- Elevation of everything on piers out of wetlands (except for pilings)
- Restoration, revegetation, creation, or replacement of wetland and submerged vegetation
- No infringement on submerged grass beds, oyster beds or fish reefs.

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[a] USDOC, 1979.

Marina applications are submitted to the USACOE Mobile District Office (from whom the application form is available). The applicant also submits a copy to DEM. The USACOE then submits a copy of the public notice to ADEM for review. ADEM is responsible for submitting a letter documenting a finding of consistency with the state Coastal Zone Management Plan. ADEM also submits all necessary certifications, including the 401 water quality certification, to the USACOE. These certifications must be submitted or an extension requested within 15 days after the end of the 30 day public comment period. The USACOE must receive the letter of consistency, denials of certification, waivers of certification or conditions to the certification before a permit decision can be made. The permit decision is typically made within 15 to 45 days after receipt of the letter of consistency.

The application form to the USACOE is submitted following selection of the site; however, the USACOE recommends a pre-application meeting to discuss the proposed project. The Memorandum of Agreement between ADEM and the USACOE relating to Section 10/Section 404 permits is included in Appendix G.

The USACOE and ADEM's Joint Public Notice is used to solicit comments from appropriate state and federal agencies. State review agencies include the Alabama Historical Commission (SHPO) for cultural resource impacts, Department of Conservation and Natural Resources, which evaluates an application for impacts on fisheries resources, and the State Docks Department, which evaluates navigational issues.

Mississippi

Overall Permitting Program

Mississippi administers state control of coastal marina development through authority contained in the Mississippi Coastal Program. The Coastal Program encompasses a number of earlier state laws including the Coastal Wetlands Protection Law. The Wetlands Law prohibits the conduct of any regulated activity unless a permit has been issued or the activity is covered by a valid exclusion. Therefore, though it appears that Mississippi does not operate an individual regulatory program, the Wetlands Law does provide a specific review and approval process within the overall coastal program. This review process is illustrated in Figure 6-7.

The state and federal programs are coordinated through the provision for a joint permit application. The permit application is provided to the U.S. Army Corps of Engineers, the Mississippi Bureau of Marine Resources (BMR) and Mississippi Bureau of Pollution Control (BPC). The Secretary of State approves submerged land leases. The Corps issues a joint public notice with BPC, which conducts the 401 review and approval where required.

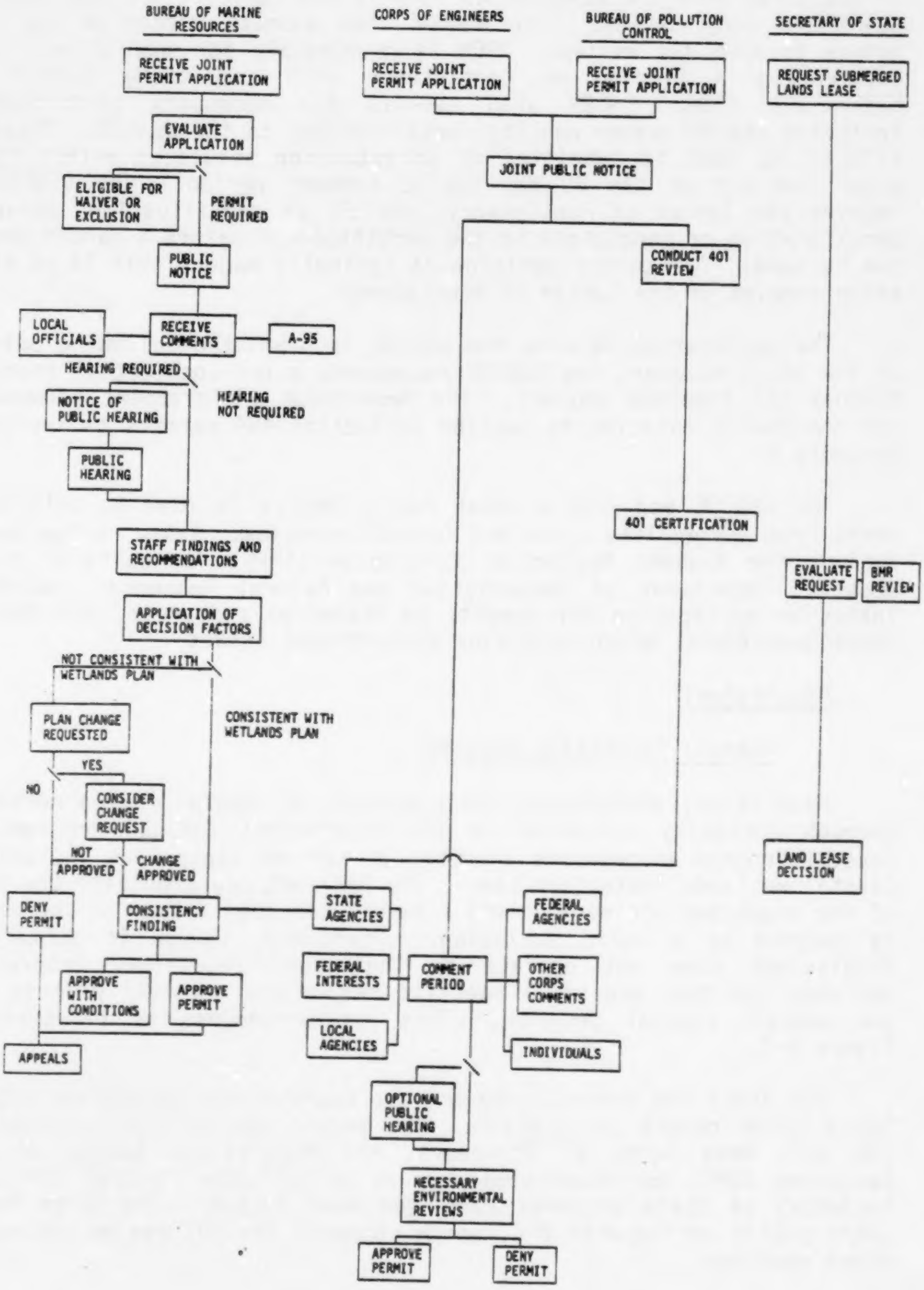
BUREAU OF MARINE RESOURCES
CORPS OF ENGINEERS
BUREAU OF POLLUTION CONTROL
SECRETARY OF STATE
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
RECEIVE JOINT PERMIT APPLICATION
REQUEST SUBMERGED LANDS LEASE
EVALUATE APPLICATION
JOINT PUBLIC NOTICE
ELIGIBLE FOR WAIVER OR EXCLUSION
PERMIT REQUIRED
CONDUCT 401 REVIEW
PUBLIC NOTICE
LOCAL OFFICIALS
RECEIVE COMMENTS
A-95
HEARING REQUIRED
NOTICE OF PUBLIC HEARING
HEARING NOT REQUIRED
PUBLIC HEARING
401 CERTIFICATION
STAFF FINDINGS AND RECOMMENDATIONS
EVALUATE REQUEST
BMR REVIEW
APPLICATION OF DECISION FACTORS
NOT CONSISTENT WITH WETLANDS PLAN
CONSISTENT WITH WETLANDS PLAN
PLAN CHANGE REQUESTED
YES
NO
CONSIDER CHANGE REQUEST
NOT APPROVED
CHANGE APPROVED
LAND LEASE DECISION
DENY PERMIT
CONSISTENCY FINDING
STATE AGENCIES
FEDERAL AGENCIES
FEDERAL INTERESTS
COMMENT PERIOD
OTHER CORPS COMMENTS
APPROVE WITH CONDITIONS
APPROVE PERMIT
LOCAL AGENCIES
INDIVIDUALS
APPEALS
OPTIONAL PUBLIC HEARING
NECESSARY ENVIRONMENTAL REVIEWS
APPROVE PERMIT
DENY PERMIT

Figure 6-7. Mississippi marina permitting process.

The BMR implements the requirements of the Wetlands Act. Upon receipt of a joint application, BMR reviews it for completeness and determines if it is eligible for a waiver or exclusion. When it is determined that a wetland permit is required, BMR will issue a public notice and invite comments. The comment process is carried out through the A-95 Clearinghouse and not through direct submission of comments to BMR. As part of this review process, BMR would consider input from BPC regarding the 401 Certfication. However, denial of the 401 Certification would not mean that a proposal would necessarily be found to be inconsistent with the wetlands plan.

The A-95 process refers to the federal Office of Management and Budget's (OMB) circular A-95, which establishes a formal review process for all actions involving federal assistance. It provides for the establishment of "clearinghouses" at state and regional levels where project information is routinely collected, reviewed, and made available for review by all other agencies and interested parties. Although the process has been substantially modified under revised OMB direction, many states and regional planning agencies have continued to perform the clearinghouse function.

Once BMR has reviewed the application, a finding of consistency is transmitted to the Corps along with other state comments. The wetlands permit is then either approved, approved with conditions, or denied. If it is determined that a revision to the wetlands use plan is required, a separate review process must be initiated. Where a proposed marina is not consistent with the wetlands use plan and a revision to the plan is not granted, the permit will not be approved. In addition to the wetland permit, a marina can not be developed unless it receives a submerged land lease from the Mississippi Secretary of State. The Corps cannot issue a Section 404 Dredge and Fill permit unless all other federal, state and local approvals are obtained, including a Section 401 Certification.

Basis for Decision-Making

Siting Criteria

Criteria used by the Mississippi Bureau of Marine Resources in evaluating the feasibility of constructing and operating a marina facility are presented in Table 6-26. There are five criteria specific to the actual siting of a marina, the first and foremost of which is whether the site is a "permitted" area for marinas as designated by the coastal wetlands use plan. Utilization of the wetlands use plan as a decision tool is the most innovative aspect of the permitting process in Mississippi. The plan establishes use categories for the coastal area and territorial waters. Based on these categories, marinas may only be permitted in certain areas. Although only activities allowed under the use plan may be granted a permit, exceptions are made based on the review process.

TABLE 6-26

STATE OF MISSISSIPPI

MARINA PERMIT EVALUATION CRITERIA[a]

- Location must be consistent with wetland use plan
- Location in areas where minimal initial dredging will be required
- Location shall be at least 1,000 feet from shellfish harvesting areas or seagrass and must avoid archaeological and historic sites
- Project shall not disrupt currents or restrict tidal flow, change salinity regimes or change related nutrient and aquatic life distribution patterns
- Location shall not be in areas of known high shoaling and siltation
- Preferred alternatives are:
  - more efficient utilization of existing marina
  - open dockage extending to deep water
  - excavation of basins in uplands vs. coastal wetlands
- Depth of boat basins and access channels shall not exceed that of receiving water body or be located in poor circulation areas and be designed to insure adequare flushing
- Indented boat slips with angled sides are preferred
- Boat basins shall be designed for tidal flushing with angled sides (or similar means) for water circulation
- Presentation of innovative solutions to increased demand for new mooring, dockage and storage space is encouraged
- Permanent dredged material disposal sites in non-wetland areas are preferred
- Application must indicate that all appropriate permits or certificates have been applied for or are not required
- Statement describing environmental effects, assessing impacts and describing measures to be taken to reduce detrimental impacts to wetlands during and after activity must be submitted.

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[a] Mississippi Department of Wildlife Conservation, 1980.

The specific site chosen for a marina must also conform to the location standards in Table 6-26.

Water Quality Criteria

Water quality criteria applicable to the use classifications for shellfish harvesting areas and fish and wildlife are described in Table 6-27. Parameters presented are those in which potentially adverse changes due to marina use may occur. Fecal coliform levels (bacteria), DO, pH and temperature may change as a result of discharge from marine sanitation devices on boats. Toxic substances, such as oil, may accidentally spill into coastal waters as a result of engine cleaning and refueling operations. Oily substances, in addition to sewage waste, will produce changes in color, taste and odor of water.

Permit evaluation criteria, imposed by the BMR, state that specific measures must be taken to insure against adverse impacts to water quality (Table 6-26). For instance, boat basins and access channels must not be located in poor circulation areas and they must be designed to insure adequate flushing of the area. Many of the evaluation criteria are designed to protect the natural quality of the environment in the long-term.

Another measure designed to protect the long-term water quality of an affected water body is the requirement that an applicant receive a Section 401 (CWA) Water Quality Certification. This Certification is applicable throughout construction and operation of the marina.

Dredge and Fill Requirements

Table 6-28 lists dredging and fill disposal requirements of the Mississippi Coastal Program. In the state of Mississippi, all dredged material is viewed as a potential reusable resource and, therefore, disposal plans are to include provisions for access to these resources.

Existing disposal sites are to be used as much as possible. New disposal must be in upland or deep water sites. Coastal areas containing submerged vegetation and regularly flooded emergent vegetation are absolutely forbidden for use as fill disposal sites. Other fill disposal regulations are presented in Table 6-28.

Permit Conditions and Mitigative Measures

Three examples of possible conditions or measures to be taken by an applicant to insure environmental protection or protection of the public interest for/during marina construction are listed in Table 6-29. These are actual conditions imposed by BMR.

The Mississippi Coastal Program has two general purposes for attaching conditions to permits: to ensure compliance with the coastal program and as a means of minimizing adverse impacts on coastal wetlands.

TABLE 6-27

STATE OF MISSISSIPPI
WATER QUALITY CRITERIA APPLICABLE TO MARINA SITING AREAS[a]

	Use Classifications Potentially Impacted by Marina Siting	
Parameter	Shellfish Harvesting Areas	Fish and Wildlife
Bacteria	Median fecal coliform MPN not > 14/100ml; not > 10% of samples shall ordinarily exceed an MPN[b] of 43/100ml in areas most probably exposed to fecal contamination during most unfavorable hydrographic & pollutional conditions	Not > geometric mean of 2000/100ml; not > 10% of samples per month should exceed 4000/100ml
Dissolved Solids		Not > 750mg/l monthly average value
Toxic Substances, Color, Taste and Odor-Producing Substances	None added that will impair use for that which it is classified; not > 1/10th of 96-hr. median tolerance limit	Same
pH	6.0-8.5 (with 1 unit variation allowed); or not to vary 1 unit from background level unless it falls within accepted range	Same
Temperature	Discharge of heated waste shall not raise temperature > 4°F (Oct thru May) or > 1.5°F (June thru Sept)	Same

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[a] Mississippi Department of Natural Resources, 1982.

[b] MPN: Most Probable Number.

TABLE 6-28

STATE OF MISSISSIPPI DREDGE SPOIL REQUIREMENTS[a]

- All dredged material shall be viewed as a potential reusable resource, and all disposal plans should include provisions for access to such resources
- Existing disposal areas shall be used to the fullest extent possible
- Disposal dikes shall be shaped and stabilized immediately upon construction to minimize erosion and dike failure, and outfalls shall be positioned to empty back into the dredged area
- Permanent, upland disposal sites or deep water disposal sites shall be used in preference to coastal wetland disposal
- Areas containing submerged vegetation and regularly flooded emergent vegetation shall not be used for spoil disposal
- Toxic and highly organic materials shall be disposed of in a manner that prevents their harmful release into the environment
- New spoil disposal proposals shall include a maintenance plan for either the life of the facility or 50 years, whichever period is shorter.

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[a] Mississippi Department of Wildlife Conservation, 1980.

TABLE 6-29

STATE OF MISSISSIPPI

EXAMPLES OF MARINA PERMIT CONDITIONS[a]

- Applicant must obtain a submerged lands lease
- Elimination of a bulkhead waterward of mean high tide as well as accompanying backfill for a sand beach which would have meant taking a portion of public trust lands
- Maintain some type of public access where possible, in areas where access is being limited.

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[a] Conditions posed by the Mississippi Bureau of Marine Resources in granting permits under the Coastal Wetlands Protection Law

As a condition, the state may require a performance bond to secure compliance with a BMR permit and its mitigative measures.

Summary of Mississippi Permit Process

Mississippi is one of the states with a unique approach to marina permitting. The state administers a consistency review and wetlands permit as a coordinated activity under the State Coastal Program. The utilization of the wetlands use plan as a tool in the decision-making process has many advantages that other states have yet to implement.

Mississippi has a specific list of criteria with which to assess the impact of marina development/use and associated uses on the environment. These criteria, along with time limits for permit review, are provided to applicants. The Mississippi list is specific to marinas and a few related uses and some of the protective requirements are more thoroughly detailed than those of other states. For example, a size is specified for the buffer zone for shellfish areas. Field representatives assist the applicant, evaluate sites and recommend alternative sites or environmental solutions.

The USACOE Mobile District (Vicksburg District if project is in the Pearl River drainage basin), the Mississippi Department of Wildlife Conservation, Bureau of Marine Resources (BMR) and Bureau of Pollution Control (BPC) require submittal of a joint permit application. Appendix G provides a sample copy of the joint application and notification form for a USACOE permit, a BMR permit and the BPC 401 water quality certification. The application also describes attachments to be forwarded with the application and applicable fees.

Permit applications are coordinated through the Mississippi State Clearinghouse for Federal Activities to ensure compliance with A-95 review requirements, and the clearinghouse forwards copies of BMR and BPC certifications to the USACOE. A permit decision may be reached within 15 to 30 days after the end of the 30 day public notice period. Otherwise a decision is made in 60 to 90 days. The BMR typically makes a decision within 90 days after receipt of the completed application. This includes receipt of all necessary federal, state and local agency approvals.

The application is submitted following selection of a potential site. However, a pre-application meeting is encouraged by both the USACOE and BMR.

Comments on a proposed project are solicited from state and federal agencies through the Public Notice procedure. State agencies which comment include the State Historic Preservation Office, which routinely evaluates permit applications for potential interference with historic/archaeological resources.

6.5.3 Analysis of Differences Between State Permit Programs

North Carolina's permit review program uses a general permit that appears to result in effective coordination between state and federal regulatory agencies. Alabama relies on indirect control of marina development through use of their coastal plan requirements and only one final approval is required. Mississippi utilizes a coordinated consistency review and wetlands permit process under the State Coastal Program. Although the three approaches to permit review are different, the outcome is essentially the same. The overall permitting procedure becomes less complicated because coordinated control results in less time spent in processing duplicated reviews and comments.

South Carolina and Georgia use the joint permit program, resulting in duplication of comments and reviews and multiple permits. The process in Georgia includes an initial review for consistency with local regulations. The permit review procedure in Florida is complex and involves several state agencies.

Another area of comparison between state guidelines is that of permit evaluation criteria. Mississippi and North and South Carolina have fairly stringent guidelines regarding marina location and design. The listings of criteria are extensive and cover most critical areas that could be impacted by marina development.

Florida also has stringent marina permitting guidelines. The Florida Department of Environmental Regulation (DER) requires preparation of extensive biological, ecological and/or hydrographic surveys to determine the extent of potential adverse effects on natural resources in the area prior to marina development. State permit approval is contingent on the results of these studies.

Georgia has a list of criteria applicable solely to marina-related use development, but it does not appear to be all-inclusive. Alabama does not have specific guidelines for marinas. Approval or disapproval of marina applications is based on adherence to other standards of the Alabama Coastal Program such as dredging and filling, public access, natural hazards and solid waste disposal. Many of these apply indirectly to marina development.

6.5.4 Local Agencies

Local agencies exercising control over coastal marina development include city, county and regional bodies. Typically, these agencies are not involved in the comprehensive evaluation of the suitability of a marina based on environmental water quality issues. Their review and approval generally covers regulations such as local land use controls, building codes, subdivision ordinances and provision and operation of public facilities. In some states, though, comments of the local jurisdiction can affect the decision on a state permit application. Local ordinances can also have a significant impact on marina use and operation.

Local involvement in North Carolina was significantly spurred by the Coastal Area Management Act. The Act required all cities and counties within the state's coastal zone to adopt land use plans, or accept plans adopted by the state. CAMA permits granted under authority of the Act must be consistent with these plans. In addition, the Act delegates to cities and counties with approved programs the authority to grant CAMA permits for minor developments.

The Georgia state program considers local government regulations at the earliest point in the permit review process. This process provides for termination of permit processing where all local approvals have not been received.

All but four of the coastal counties have adopted zoning and subdivision regulations in Florida. However, most coastal communities do not have plans or regulations that directly address marinas. Even where they are addressed in the local zoning ordinance, it is only to prohibit them in residential areas. Significant exceptions to this situation are Jacksonville, St. Petersburg and Dade County, which have either commissioned or conducted marina studies (Maloney et al., 1980). The Florida state permitting program under DER also has an initial review which halts the application process until local approvals are received. Many Florida communities are now addressing marinas through their local government's Comprehensive Plan (LGCP).

Eleven of the 14 coastal municipalities in Alabama have adopted zoning ordinances and all but four have adopted subdivision regulations. Although approval by local agencies is not a requirement of the state review process, the Coastal Area Management Program does provide delegation of review authority for non-regulated uses to local governments with approved programs.

The Mississippi state regulatory program does not require applications to be consistent with local plans and programs. Applicants must, however, certify that all necessary building and zoning permits have been applied for or are not required. There is also an extensive requirement for coordination with local agencies. For example, notice and information on all permit requests must be circulated through the state A-95 clearinghouse. Furthermore, notice of any proposal to revise the wetlands use plan must be provided to the port and harbor commissions, development commissions and boards of supervisors in the coastal counties.

Local agencies are increasingly exercising control over marinas. Appendix D presents examples of ordinances, regulations and agreements relating to coastal marinas and liveaboard boat wastewater disposal. They are good illustrations of the potential impact and extent well written, comprehensive local and regional laws can have on coastal marina design and operation in regards to wastewater collection and treatment from boats. The laws are also significant in the protection of the environment and public health in the vicinity of marinas with liveaboard vessels. Summaries of each of the appendices follow.

Appendix D.1 - This is a proposed Dade County, Florida ordinance creating an Operating Permit Program for recreational and commercial boat docking facilities. All recreational and commercial marinas with docking facilities for 10 or more vessels must apply for an operating permit. The permit specifies that a recreational marina must have sewage pumpout stations and sewage pumpout connections for houseboat liveaboards. The ordinance calls for appointment of a technical advisory committee (by the county manager) to study methods for direct sewage pumpout for cruising liveaboards and make recommendations. Transient vessels will remain exempt from direct pumpout requirements if they have a USCG-approved marine sanitation device (MSD) under this ordinance. Commercial marinas are required to have upland sanitary facilities.

The Dade County ordinance also has provisions for control of boat maintenance and repair activities at marinas, stormwater disposal system maintenance, trash and litter control and reporting requirements. Property owners providing dockage for 1-9 houseboat liveaboards must provide "direct sewage pumpout connections".

Appendix D.2 - Appendix D.3 presents ordinances and agreements relating to regulations by the San Francisco Bay Conservation and Development Commission (BCDC). The BCDC regulation section 10722 established a permit program for marinas. The permits limit the number of liveaboard vessels to be berthed at each marina and impose conditions on liveaboards. Liveaboard vessels are required to seal all through-the-hull fittings and must have a MSD type III holding tank. Marinas are required to provide pumpout facilities and to carefully monitor (log in) use of such facilities. BCDC can require that liveaboards permanently connect to shoreside wastewater disposal facilities. Marinas are required to report to BCDC annually. The report is to include data on fecal coliform bacteria in the waters of the basin and surrounding areas, the extent and diversity of the benthological community, and pumpout logs among other information. It is interesting to note that BCDC law considers liveaboard vessels a form of fill and that the vessels must adhere to some fill regulations and requirements as well.

Besides the BCDC regulation, this appendix contains City of Berkeley, California ordinances (No. 5032 and 5226) defining rules and regulations for the Berkeley munucipal marina. These regulations follow the BCDC ordinance and define authority, duties and fees. A copy of a letter in this appendix outlines minimum MSD holding tank capacities that will be approved for various liveaboard vessels.

Also included in Appendix D.2 is a sample agreement between the City of Berkeley and the "Berther" which outlines the responsibilities of the liveaboard owner/inhabitant.

Appendix D-3 - Appendix D.3 contains several Marin County, California, ordinances. One ordinance (Chapter 11.20) on "Moorage and Occupancy of Vessels" provides for issuance of occupancy permits by the county public health department. Another ordinance (1693) regulates "Floating Home Marinas". One provision of this ordinance is that floating homes are required to be connected to an onshore wastewater disposal system. A marina containing floating homes must provide the "lateral" collection system.

A relatively unique ordinance (Marin County - Chapter 19.18) in D.3 is "Regulation of the Construction and Maintenance of Floating Homes". This ordinance defines a floating home as any liveaboard craft and sets out fairly detailed design and construction criteria for these vessels. The regulations are similar to conventional building codes. In the design criteria are specifications on dimensions of required holding tanks for all wastewater and "ejector devices" for connection to onshore systems.

6.6 Summary

In every USEPA Region IV state there are multiple agencies directly involved in the marina permitting process. Overlap because of the multiple agency involvement may result in unnecessary expenditures of time and effort by both permit applicants and agency staff.

Two approaches have been used to better coordinate permitting among agencies. The first approach is the joint permit program. Using this approach, one application is made for both federal and state permits. In some cases the receipt and review of comments is also carried out jointly, but the permit decision is a separate action in every case. Even when using the joint permit process there are cases where state and federal agencies review separate sets of comments at different times in the review process. At the end of the review process, it is also possible that a state permit may be granted while a permit from the USACOE may be denied.

The second approach that has been employed to coordinate state and federal permitting roles is the granting of permitting authority to a state under a general permit issued by the USACOE. This approach is unique to North Carolina where the Wilmington District has executed a general permit for activities covered under Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. This general permit authorizes Section 10/Section 404 activities that have received prior approval from the State of North Carolina. Such prior approval would include all of the following authorizations when required:

- Coastal Area Management Act (CAMA)
- Permit to dredge and fill
- 401 water quality certification.

The general permit agreement does not eliminate USACOE involvement in the decision-making process, but it does eliminate duplication of effort for routine projects by eliminating parallel permit review processes by both the USACOE and the state.

Other desirable regulatory program features, some of which are already included in some state regulatory programs, are:

- Formal agreements such as memoranda of understanding adopted between state agencies to aid in coordinating review procedures and responsibilities
- Clear, objective permit decision-making criteria that are made available to applicants and explained at pre-application meetings
- The permitting process may be further streamlined by what might be called a "cooperative outreach program". Such a program would center on the use of agency field representatives who are now used in a number of states. In addition, it would combine other desirable regulatory features into a program targeted to assist the applicant and lessen the probability of reviewing nonpermittable applications. A cooperative program would include the following elements:
    - field representative to provide assistance with siting and mitigation
    - permitting handbook describing the permitting process including flow charts and decision-making criteria
    - pre-application conference in conjunction with a method for notifying applicant of the benefits from such a conference
    - designation of a single agency contact person to track a given permit and assist applicant.

Another consideration regarding agency functions is the primary focus on water quality and wetland impacts. Most of the permitting programs at both the federal and state levels address marina permitting primarily in terms of water quality and wetland impacts. Emphasizing these major impact areas is justified but development of a marina represents a major change in land/water use. A more comprehensive planning approach may be beneficial in regulating these activities.

Closely related to this issue is the lack of well-defined planning and resource managment functions from some key federal and state agencies. Only two state programs (Mississippi and North Carolina) are designed from a planning perspective to address most of the resources that can be impacted by marina development. Most states have extensive resource inventories that could provide the base for developing some type of general plan for areas most suitable for marina development. Although this approach would not eliminate the need for a detailed evaluation of individual marina permit applications, it could lessen the number of unpermittable applications received and expedite the marina permitting process.

The federal agencies involved in the marina permitting and review process include the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service and the U.S. Coast Guard. Federal involvement in the coastal marina permitting process is primarily through Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act. Section 10, River and Harbor Act, authorizes dredging, filling and construction activities in navigable waters of the United States. Section 404, Clean Water Act, authorizes the Corps of Engineers to issue permits for the discharge of dredged or fill materials into the waters of the United States. It does not authorize the Corps to regulate dredging in these waters. In many cases it overlaps the Corps' authorities under Section 10 of the River and Harbor Act.

In processing Section 404 permits the Corps applies Section 404(b) discharge site specification guidelines developed by the Environmental Protection Agency in consultation with the Corps. Other legislation to be considered in the Corps permitting process includes (but is not limited to) the National Environmental Policy Act, the Fish and Wildlife Coordination Act, the Coastal Zone Management Act, the Endangered Species Act, the Wild and Scenic Rivers Act, and the National Historic Preservation Act.

The number of state agencies involved in the federal or state permitting and review processes vary from state to state. State agencies take 60 to 90 days in reaching a permit decision. These time frames may be extended if applications are incomplete or inadequate. The USACOE normally awaits a state permit decision before the decision on a Section 10/404 permit is made. If the state permit or certification is denied, the USACOE permit will also be denied. The USACOE typically makes a permit decision within 60 days following receipt of the completed permit application.

Several permits, certifications and approvals may be required before construction of a new marina can begin. These include:

- Section 10 permit from the U.S. Army Corps of Engineers for any construction activities in navigable waters
- Section 404 permit for any discharge of dredged or fill material into waters of the United States including adjacent wetlands
- Section 401 water quality certification from the state
- State dredge and fill permit where applicable

- Regional and local permits, approvals and authorizations as required.

Most marina developments will require a Section 10/Section 404 permit with a Section 401 water quality certification. State dredge and fill permits may be required as well as regional or local authorizations. Because of the complexity of the marina permitting process, it is important for the planner or developer to request and participate in a pre-application conference with permitting agencies after the site has been selected. This type of conference is recommended by most permitting agencies. Required regional and local permits, approvals or authorizations should be quickly identified as well. The pre-application conference and early identification of required permits, approvals and authorizations will facilitate the marina permitting process.

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8.0 GLOSSARY

ADSORPTION

The adherence of the atoms, ions, or molecules of a gas or liquid to the surface of another substance (the adsorbent). Adsorption is often used to extract pollutants by causing them to be attached to adsorbents such as activated carbon or silica gel. Some adsorbents are used to extract oils from waterways in oil spills.

ADVECTION

Average velocity over some space or time scale. Advection is caused by relatively large scale water movements transporting the given property and thus effecting a local change in concentration.

AIR CURTAIN (Bubble Screen)

A method for mechanical containment of oil spills. Air is bubbled through a perforated pipe, causing an upward water flow that retards the spreading of oil. Air curtains are also used as barriers to prevent fish from entering a polluted body of water.

ASYMPTOTE

A line considered a limit to a curve in the sense that the perpendicular distance from a moving point on the curve to the line approaches zero as the point moves an infinite distance from the origin.

BARRIER ISLAND

Islands of narrow strips of sand protecting gently sloping coastal mainland.

BASELINE STUDY, ECOLOGICAL

Any investigation conducted prior to the "breaking of ground" in order to provide an ecological basis for decisions on whether, where and how to accomplish a proposed development. The scope of study may range widely from qualitative inventories conducted by natural resource managers to exhaustive quantitative studies of specific development sites undertaken by industry in compliance with federal and state regulations. The results of an ecological baseline study describe the existing ecological conditions and trends in the potentially affected region, providing a reference "baseline" from which environmental scientists can (1) predict the effects of the proposed action and recommend alternatives, (2) define appropriate mitigation measures, and (3) design future programs to monitor the accuracy of predictions and the effectiveness of mitigation.

BATHYMETRIC

Relating to the measurement of depths of water in oceans, seas, and lakes.

BENTHOS

Organisms growing on or associated principally with the water bottom.

BILGE WATER

Water that collects in the lowest inner part of a ship's hull.

BIOASSAY

1. Determination of the physiological effect of a substance (such as a drug) by comparing its effects on a test organ or living organism with that of some standard substance.

2. Determination of the concentration of a substance (e.g., a pesticide residue) in the tissues of an organ or organism.

BIOCHEMICAL OXYGEN DEMAND (BOD: Biological Oxygen Demand)

A measure of the demand on a water body's dissolved oxygen supply that will be generated, over a specified time period, by the biological decomposition of organic material. A high BOD may temporarily or permanently so deplete the oxygen in water that aquatic life is killed.

BIODEGRADATION

The biochemical breakdown of complex, large, organic molecules into small simple molecules; decomposition by bacteria, fungi and other microorganisms.

BIOMASS

The total weight of living and dead matter in organisms, often expressed per unit volume or area.

BIOTA

All of the named or nameable organisms of an area; fauna and flora (biota) of a region.

BIOTIC

Environmental factors which are the result of living organisms and their activities.

BOAT BASIN

Naturally or artificially enclosed or nearly enclosed harbor area for small craft.

BREAKWATER

Structure protecting shore area, harbor, anchorage, or basin from waves.

BREAKER ZONE

Zone of shoreline where waves break.

BUFFER ZONE

An area between a marina and a shellfish growing area usually based on hydrography and the size of the marina established in order to protect shellfish growing areas.

BULKHEAD

Structure or partition built to prevent sliding of the land behind it.

CANAL

Artificial watercourse cut through land area.

CHEMICAL OXYGEN DEMAND (COD)

A measure of the amount of a water body's dissolved oxygen supply that would be used up in completely oxidizing added inorganic oxidizable compounds - such as in the oxidation of ammonia to nitrate. Biological oxygen demand (BOD) tests can measure only the biodegradable fraction of the total potential dissolved oxygen consumption by added wastes; however, COD tests may be used to measure the oxygen demand created by toxic organic or inorganic compounds as well as by biodegradable substances. A standard COD test, therefore, can be used to evaluate many industrial wastes not readily analyzed for water quality factors by the sewage-oriented BOD test.

CIRCULATION

The act of circulating; passage or transmission from place to place.

CONCENTRATION

The amount of a substance occurring in a given amount of air, water, soil, tissue, etc. May be expressed as parts per million, grams per liter, or in other units suitable to the substance of interest.

COST-BENEFIT ANALYSIS

Economic analysis that yields a ratio between anticipated benefits and costs, thus showing the relative economic efficiency of a project or program.

COVER, VEGETATIVE (Coverage)

The portion of the ground occupied by a perpendicular projection to the ground from the outline of the aerial parts of plants.

COVER, WILDLIFE

The plants or other objects used by animals for nesting, rearing of young, resting, escaping from predators or avoiding adverse environmental conditions.

CRITICAL HABITAT

See HABITAT, CRITICAL

CULTCH

An artificially placed hard substrate such as clam or oyster shell that is placed on the bottom to create a suitable substrate for colonization by larval shellfish.

DENSITY (Stand Density)

The number of individuals of a defined group occurring in a specified unit of space; refers to the average distance between adjacent individuals.

DEPURATION

The rate at which the organism can rid itself of body burdens when placed in uncontaminated water.

DESIGN WAVE HEIGHT

Wave which is used for designing coastal structures such as revetments, breakwaters, jetties or groins. The wave height and period assists the designer in selecting sizes of armor units and other features of the structure.

DILUTION

Reduction in concentration of a pollutant.

DISPERSION

To distribute, as finely divided particles, more or less evenly throughout a water body.

DISSOLVED OXYGEN

The extent to which oxygen occurs in solution in water or wastewater; usually expressed as concentration, in parts per million, or percent of saturation.

DISTURBED LAND

Land that has been altered physically, biologically or chemically by the action of man; e.g., land on which excavation has occurred or upon which overburden has been deposited.

DIVERSION

Channel constructed across the slope for the purpose of intercepting surface runoff. Changing the accustomed course of all or part of a stream. Also, a ditch or canal by which water is diverted from one stream to another.

DIVERSION DIKE

A ridge of compacted soil placed above, below or around a disturbed area to intercept runoff and divert it to a disposal area.

DIVERSION DITCH (Diversion Swale)

An excavated, temporary drainageway used above and below disturbed areas to intercept runoff and divert it to a safe disposal area.

DRAINAGE BASIN (Catchment Area, Watershed)

The preferred term for that part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

DOCK

Place for loading and unloading of vessels/for small boats.

DREDGED BASIN

An artificially enclosed area of a river or harbor.

EBB FLOW

The period of tidal flow between high tide and a succeeding low tide.

ECOLOGY

The study of the interactions between organisms and their living and non-living environment (including interactions with each other).

ECOSYSTEM

An assemblage of living organisms (biotic community) plus their nonliving (abiotic) environment.

EFFLUENT

A discharge of pollutants into the environment, generally used in regard to discharges into waters.

ELUTRIATE TEST

Laboratory procedure designed to simulate the disposal of hydraulically dredged sediments with respect to the release of chemical contaminants from the sediments during dredging and subsequent disposal operations.

EMPIRICAL

Relying on observation or experiment; guided by experience rather than theory.

ENDANGERED SPECIES

1. An endangered species, or subspecies, of animal or plant is one whose prospects of survival and reproduction are in immediate jeopardy.

2. Its peril may result from one or many causes: loss of habitat or change in habitat, overexploitation, predation, competition, disease or even unknown reasons. To survive, an endangered species must receive the assistance of man through habitat preservation and development and legislated protection.

ENVIRONMENT

The sum of all external conditions and influences affecting the life, development and ultimately the survival of an organism.

ENVIRONMENTAL ANALYSIS REPORT (E.A.R.)

A report on environmental effects of proposed Federal actions that may require an Environmental Impact Statement (EIS) under Section 102 of the National Environmental Policy Act (NEPA). The EAR is an "in-house" document of various degrees of formality that becomes the final document on environmental impacts for those projects that, because their effects are minor, do not require a formal EIS. Although not formally prescribed under NEPA, the EAR is the document normally used to determine whether Section 102 of NEPA applies to the project in question, and as such is subject to court challenge if no EIS is filed.

EROSION

Wearing away of land by forces, e.g., by wave action, tidal currents, and littoral currents.

ESTIMATE

Measurements and observations of a particular parameter, process, or response. The accuracy and precision of an estimate depend on the instruments employed and the experimental design in which it was obtained.

ESTUARIES

Areas where fresh water meets salt water (e.g., bays, mouths of rivers, salt marshes and lagoons). Estuaries are delicate ecosystems, serving as nurseries and spawning and feeding grounds for a wide variety of marine life and providing shelter and food for birds and wildlife.

FAIRWAY

A navigable deep-water chennel in a river or harbor or along a coastline.

FAUNA

The animal life of a given area or period.

FIRST-ORDER DECAY OF POLLUTANT

When the rate of decay is directly proportional to the concentration of the pollutant.

FISH, GAME (Sport Fish)

A species of fish considered to possess sporting qualities on fishing tackle. Examples of fresh water game fishes are salmon, trout, grayling, black bass, muskellunge, walleye, northern pike and lake trout.

FLOOD TIDE

The rising tide.

FLORA

The plant life of a given area or period.

FLUSHING TIME

1. The measure of the time required to transport a conservative pollutant from some specified location.

2. The volume of the estuary divided by the water flux rate; a useful figure for assessing load capacities.

FROUDE NUMBER

The Froude Number is the ratio of the boat speed and the speed of a wave in shallow water. The wave speed is a function of the basin depth.

GABION

Hollow cylinder filled with earth.

GRADE

1. Common usage: The inclination or slope of a stream channel or ground surface, usually expressed in terms of the ratio or percentage of number of units of vertical rise or fall per unit of horizontal distance.

2. The finished surface of a road bed, top of an embankment, or bottom of an excavation.

3. To establish a profile by backfilling.

GROIN

A rigid structure built at an angle (usually perpendicular) from the shore to protect it from erosion or to trap sand. A groin may be be further defined as permeable or impermeable depending on whether or not it is designed to pass sand through it.

GROUNDWATER

Subsurface water occupying the saturation zone (where all openings in soils and rocks are filled), from which wells and springs are fed. In a strict sense the term applies only to water below the water table.

HABITAT

The place, and the characteristics and conditions of that place, where an organism lives.

HABITAT, CRITICAL

Any air, land or water area, including any elements thereof, that the Secretary of the Interior, through the Director, U.S. Fish and Wildlife Service or National Marine Fishery Service, has determined is essential to the survival of wild populations of a listed species or to its recovery to a point at which the measures provided pursuant to the Endangered Species Act of 1973 are no longer necessary. Such determinations are published in the Federal Register.

HEAVY METALS

Metallic elements of high molecular weight, generally toxic to plant and animal life in low concentrations. Such metals are often residual in the environment and exhibit biological accumulation. Examples include mercury, chromium, cadmium, arsenic and lead.

IMPACT

An observed effect that occurs in an ecosystem as the result of an environmental perturbation.

IMPACT, ACCUMULATIVE

The total effect over time resulting from the sum of the variety of environmental perturbations produced by one facility.

IMPACT, DIRECT (Primary Impact)

Direct or primary impacts are those in which the causative agent impinges directly upon the responding ecological components, e.g., land clearing for construction causes direct loss of vegetation.

IMPACT, ECOLOGICAL

The observable effects, or suspected effects, of one or more perturbations on the biota of an environmental system.

IMPACT, INDIRECT (Secondary or Tertiary Impact)

Indirect or secondary effects are those in which man-caused change in the environment creates one or more intermediary effects in a chain of events leading to the observation of the impact. Certain agencies (e.g., USEPA) distinguish between indirect and secondary impacts. For example, an indirect impact occurs when construction of a dam causes reduction of stream flow, which in turn causes elimination of riverine wetlands downstream. Secondary impacts occur when a wastewater treatment project induces urbanization which, in turn, has environmental impacts.

IMPACT, LONG-TERM AND SHORT-TERM

These terms refer to the relative duration of an impact. No strict definition of the relative time frames involved in short- and long-term impacts exists, so a time frame should be specified whenever either word is used. Generally, long-term impacts are those lasting for the duration of the project or longer. Short-term impacts are generally those lasting only during the construction phase or occurring for brief periods during the operation of the facility.

IMPACT(S), MODERATE AND SEVERE

Moderate and severe effects are gradations of adverse impacts. Moderate can be characterized as partial elimination, dislocation, impairment, or alteration of biota or use of resources and facilities. Severe can be characterized by total elimination, dislocation, impairment or alteration of biota or use of resources and facilities.

IMPACT, SIGNIFICANT

Any impact resulting in measurable changes in indicator parameters or community dynamics (such as reduced primary production).

INVENTORY, SPECIES
A census of the flora and/or fauna inhabiting a defined area. The level of resolution of such a listing varies with the objectives of the study and may range from a listing of a few conspicuous or predominant species to a complete list for the area. A species inventory does not necessarily constitute an ecological baseline study and the two phases should not be used interchangeably.

INVERTEBRATE
Animal lacking an internal skeletal structure, e.g., insects, mollusks, crayfish, etc.

JETTY
A structure built out into a body of water to influence currents, tides or waves for protection of a harbor or shoreline.

JTU (Jackson Turbidity Units)
An arbitrary scale used as a basis to measure changes in turbidity.

LAND USE PATTERNS
Natural or imposed configurations resulting from spatial arrangement of the different uses to which various plots of ground are put at a particular time.

LEACHING
Extraction of dissolved or suspended materials from a solid by a liquid.

LITTORAL
Of or pertaining to a shore.

LITTORAL DRIFT
Sedimentary material in littoral zone under influence of waves and currents.

LITTORAL TRANSPORT
Movement of littoral drift by waves and currents; includes movement parallel to and perpendicular to shore.

LOCKED-HARBOR
Marine harbor that is or can be separated from adjacent waterway by a mechanical device such as a lock or tide gate.

MARINA
Small boat harbor or boat basin providing dockage, supplies, and services for small pleasure craft.

MIGRATION
Mass movement of animals to and from feeding, reproduction, or resting areas.

MEAN HIGH WATER

Average height of high waters over a 19 year period.

MEAN LOW WATER

Average height of low waters over a 19 year period.

MEAN TIDE LEVEL

Plane midway between mean high water and mean low water (also half-tide level).

MITIGATION, IMPACT

Specific procedures to reduce or avoid potential impacts of development on the environment.

MIXING ZONE

Zone of initial dilution in the immediate area of a point source of pollution.

MODEL

A representation or abstraction of a real system; an attempt to present some of the important features of the real system in a simplified way to aid understanding. Models may use words, pictures or mathematics to present the abstractions.

MONITORING PROGRAM, ENVIRONMENTAL

A program for measuring anticipated disturbances in environmental systems. The program often includes certain aspects of the baseline study program selected for their abiltiy to detect alterations in local ecsosytems caused by the project of interest. Monitoring programs are often subdivided into construction, operations and post-operational stage monitoring programs.

NET FLOW

The net movement of a water mass that is carried back and forth by the oscillatory motion of the tides. Net flow is typically seaward for estuaries, although it is possible to have a net upstream flow in individual embayments of an estuary where freshwater inflows are so small that surface evaporation exceeds freshwater inflow.

NONPOINT SOURCE

Any non-confined area from which pollutants are discharged into a body of water, i.e., agricultural runoff, urban runoff and sedimentation from construction sites.

NURSERY

Area where young are born and cared for.

NUTRIENTS

Elements or compounds essential as raw material for organism growth and development; e.g., carbon, phosphorus, oxygen and nitrogen.

ONE-DIMENSIONAL
A vertically well-mixed estuarine system.

OPEN MARINA
Marina designs consisting of piers and/or docks extending into a coastal water with minimal protective impermeable barriers.

ORIENTATION
Arrangement in any established position especially in relation to the points of the compass.

OUTFALL
Structure extending into a body of water for the purpose of discharging an effluent (sewage, storm runoff, cooling water).

PARAMETER
1. A quantity that characterizes or describes a statistical population (e.g., a population mean); it is estimated by a sample statistic.

2. In systems ecology, a quantified estimate or measurement of the value of an attribute of a component of an ecological system; e.g., the parameter gm/m^2 provides a measure of biomass (attribute) for some species or group of species of organisms for a given site.

PATHOGEN
Any agent that causes disease, especially a microorganism such as a bacterium or fungus.

PERTURBATION, ENVIRONMENTAL
A disturbance that occurs in an environmental system resulting in a measurable change in components or processes of that system.

PIER
A structure, usually of open construction, extending into the water from the shore. It serves as a landing and moving place for vessels or for recreational uses. Includes trestles, platforms and docks.

PILE
Long, heavy timber or section of concrete or metal driven or jetted into earth or sealed for support or protection.

PLUGS
A small section of sod containing grass and roots.

POINT SOURCE
A stationary emitting point of a pollutant, e.g., a discharge pipe; in contrast to an area source or a nonpoint source.

POLLUTANT

Any contaminant that, when present in the air or water, detracts from or interferes with the desired use or natural state of that air or water.

POLLUTANT, CONSERVATIVE

A pollutant that is relatively persistent and resistant to degradation, such as PCB and most chlorinated hydrocarbon insecticides.

POLLUTANT, NONCONSERVATIVE

A pollutant that is quickly degraded and lacks persistence, such as most organophosphate insecticides.

POLLUTION

An undesirable change in the physical, chemical or biological characteristics of air, land and water that may or will harmfully affect human, plant, or animal life, industrial processes, living conditions, or cultural assets; or that may or will waste or deteriorate raw material resources. See POLLUTANT.

PPT

Represents parts per thousand by mass. Sometimes the symbol 0/00 is used.

PRODUCTION

1. The amount of organic material produced by biological activity in a given area or volume.

2. The total amount of energy stored over a specified period by an organism or organisms.

RAMP

A uniformly sloping platform walkway, or driveway. The ramp commonly seen in the coastal environment is the launching ramp which is a sloping platform for launching small caft.

RARE SPECIES

1. Species occurring as a very few individuals or small groups at widely scattered localities over a large geographic area of what appears to be suitable habitat.

2. Species found in very small numbers widely dispersed in each community where they grow, but which occur in many suitable areas over their geographic range.

3. Species with a range restricted to so few localities that they are considered rare even though they occur in large numbers at each locality.

RECLAMATION (Rehabilitation)

1. The process of reconverting disturbed land to its former or other productive uses.

2. The process of making a site habitable to organisms that were originally present or others that apporoximate the original inhabitants.

RECRUITMENT

Addition of mature individuals to a population through reproduction and survival.

REGRESSION

1. Simple: A statistical analysis procedure in which an algebraic relationship (a simple regression equation) is derived that describes how the magnitude of a variable (the dependent variable) changes with the magnitude of a second variable (the independent variable) and determines whether the relationship is statistically significant.

2. Multiple: A statistical analysis procedure in which an algebraic relationship (a multiple regression equation) is derived that describes how the magnitude of a variable (the dependent variable) changes with the magnitudes of two or more variables (independent variables) and determines whether each of the independent variables has a statistically significant effect on the dependent variable.

RESIDENCE TIME

The measure of time required before a pollutant is transported from some specified location.

RESTORATION

The process of restoring site conditions to the way they were before occurrence of land disturbance.

REVETMENT

A sloped facing built to protect existing land or newly created embankments against erosion by wave action, currents, or weather. Revetments are usually placed parallel to the natural shoreline.

RIPRAP

Larger facing, or protection mound of stones randomly placed to prevent erosion, scour, or sloughing of structure or embankment; see revetment.

ROOKERY AREA

A breeding place of rooks or certain animals.

RUNOFF

The portion of rainfall that is not absorbed into the ground. It is utilized by vegetation or lost by evaporation or it may find its way into streams as surface flow.

RUNOFF CURVE NUMBER (RCN)

An indicator of the runoff potential based on physical characteristics of an area.

SAMPLE

The part of a population that is collected or measured, usually through a deliberate selection procedure, for the purpose of drawing conclusions about the properties of the parent population.

SECTION 10 PERMIT

Permit issued by USACOE under Section 10 of the River and Harbor Act of 1899 for construction activities either in navigable waters or outside navigable waters if the activity may impact navigable waters.

SECTION 401 CERTIFICATION

Under Section 401 of the Clean Water Act-a state must certify that a proposed activity will not violate any state water quality requirement.

SECTION 404 PERMITS

State or EPA issued permits under Section 404 of the Clean Water Act that regulates the discharge of dredged or fill materials into waters of the United States.

SEDIMENT

Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

SEDIMENT TRAP (Sediment Basin)

A small temporary basin formed by an excavation and/or embankment to intercept sediment-laden runoff and to trap and retain the sediment. In so doing, drainageways, properties and rights-of-way below the trap are protected from sedimentation.

SEDIMENTATION

Process of deposition of material, usually soil or organic detritus, in the bottom of a liquid.

SEMI-ENCLOSED MARINA BASIN

An enclosed area of a river or harbor that has one opening and is otherwise protected by geographical barriers (See Figure 3-5 for representation).

SENSITIVITY

A physiological condition of susceptible organisms or tissues whereby they are prone to injury by pollutants.

SHOAL
A sandy elevation of the bottom of a body of water, constituting a hazard to navigation.

SHORELINE, ERODING
Shoreline which, by wave action, current, boat activity or frequent storm activity is losing material.

SILT
Finely divided particles of soil or rock that are often carried in cloudy suspension in water and eventually deposited as sediment.

SILT SCREEN (Sediment Curtain)
A screen used to confine suspended sediments in sensitive areas such as those near shellfish beds or grass beds.

SLIP
Berthing space between two piers.

SOIL
The surface layer of the earth ranging in thickness from a few inches to several feet. It is composed of finely divided rock debris mixed with decomposing vegetative and animal matter and is capable of supporting plant growth.

SOUNDING LINE
A line, wire, or cord for sounding that is weighted at one end and is divided for sounding by hand.

SOURCE
In systems ecology, an infinite supply outside the system of interest for flows of matter or energy.

SPECIES, GAME
1. Wild animals, usually mammals, fishes, or birds hunted for sport or food and subject to legal regulations.

2. U.S. Forest Service usage: any species of wildlife for which seasons and bag limits have been prescribed, and which are normally restricted to possession by sportspersons under state laws and regulations.

STOKES LAW
A relationship to determine terminal settling velocity of a particle in a fluid considering the parameters of gravity, fluid viscosity, density of the fluid, density of the particle, and particle diameter.

SUSPENDED SOLIDS (SS)
Small particles of solid pollutants that resist separation by conventional means. SS (along with BOD) is used as a measurement of water quality and an indicator of waste treatment plant efficiency.

TERRESTRIAL

Growing or living on or peculiar to the land, as opposed to the aquatic environment.

TETRAPOD REVETMENT

A revetment composed of large reinforced concrete structures having four arms.

THREATENED SPECIES

Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and which has been designated in the Federal Register by the Secretary of the Interior as a threatened species.

This includes species categorized as rare, very rare or depleted. Many states also have lists of threatened species which may be more encompassing, for various reasons, than the Federal lists.

TIDAL CREEK

A creek that is influenced by tidal fluctuations.

TIDAL FLAT

The sea bottom, usually wide, flat, muddy and unvegetated which is exposed at low tide; marshy or muddy area that is covered and uncovered by the rise and fall of the tide.

TIDAL PRISM

That volume of water which enters an estuary during an incoming (flood) tide and equals high tide estuarine volume minus low tide volume.

TIME CONCENTRATION CURVE

In hydrographic studies using dye release methods, the curve generated by plotting measured dye concentrations at specified locations against time intervals after dye release. The area under the time concentration curve may be divided by the amount of dye released to calculate the flow available for dilution of a pollutant.

TOXIC

Possessing the quality of being able to produce deleterious effects on the physiological processes of an organism.

TOXICITY

The quality, state or relative degree of being toxic or poisonous; the ability of a chemical molecule or compound to produce injury when it reaches a susceptible site in the body.

TURBIDITY

A measure of the optical clarity of water, and is dependent upon the light scattering and absorption characteristics of both suspended and dissolved material in the water column.

TURFS

Sections of the surface layer of soil containing a dense growth of grass and its matted roots.

TURIONS

Detached winter buds by means of which many aquatic plants survive winter.

TWO DIMENSIONAL

Estuary that is vertically stratified.

WATER QUALITY

A term used to describe the chemical, physical and biological characteristics of water in respect to its suitability for a particular use.

WATER QUALITY CRITERIA

The types and concentrations of pollutants that affect the suitability of water for a given use.

WATER QUALITY INDEX

An index developed through either an arithmetic or geometric model, which includes quantitative data from certain basic water quality indicators, which allows a ranking of the quality of natural waters according to excellent, very good, good, poor, bad or other similar categorizations, based on accompanying numerical ranking from 0 to 100.

WATER QUALITY STANDARD

A requirement for water quality specifying: 1) the use to be made of the water (recreation, fish and wildlife, drinking water, industrial or agricultural); 2) criteria with which to measure and protect these uses; 3) implementation and enforcement plans; and 4) an antidegradation statement to protect existing water quality.

WATER TABLE

The upper surface of the groundwater or that depth below which the soil is saturated with water. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water. In wells that penetrate to greater depths, the water level will stand above or below the water table if an upward or downward component of groundwater flow exists.

WEEP HOLES

Drainage hole in a structure allowing release of groundwater to prevent a buildup of water behind the structure.

WILDLIFE

1. U.S. Forest Service usage: All nondomesticated mammals, birds, reptiles and amphibians living in a natural environment, including both game species and nongame species, whether considered beneficial or otherwise. Feral animals such as wild horses, burros, and hogs are not considered wildlife.

2. Undomesticated vertebrate animals, except fishes, considered collectively.

3. Generally, all nondomesticated animal life.

4. More particularly, a loose term that includes nondomesticated vertebrates, especially mammals, birds and fishes and some of the higher invertebrates (such as crabs, crayfish, etc.).

5. Living things that are neither plant, nor human, nor domesticated, especially the mammals, birds and fishes that are hunted by man for sport or food.

APPENDIX A

MEASUREMENT TECHNIQUES FOR IMPACT AREAS

MODELS THAT MAY BE ADAPTED TO MARINA IMPACT ASSESSMENT[a]

Impact	Technique	Reference[b]
Water quality	CEM Tributary Model	1
	DOSAG-1 Model	1
	QUAL-II Model	1
	RECEIV-II Model	2
Groundwater	Various Numerical Models	3
	Flow and Transport Models	4
Socioeconomic	Input-Output Analyses	5-7
Navigation	Wind-Wave Energy Models	8-10

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[a] Various screening procedures for pollutants are discussed with examples in USEPA, 1982; Procedures for assessing impacts from small structures and related activities in coastal waters are discussed with examples in Carstea et al., 1975; various environmental quality assessment techniques are reviewed in Henderson, 1982.

[b] Golden et al., 1979; 2) USEPA, 1976; 3) Bachmat et al., 1980; 4) Mercer and Faust, 1981; 5) Nelson et al., 1980; 6) Crompton and Ditton, 1975; 7) Nissan and Williams, 1980; 8) USACOE, 1978; 9)Sverdrup and Munk, 1947; 10) Zabawa and Ostrum, 1980.

WATER QUALITY RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	Unit of Measurement	Reference[a]	Time Frame[b]
Turbidity	Secchi disk[c]	Centimeters	1-6	*In situ*
	Jackson candle turbidimeter	Jackson turbidity units	1-6	*In situ*
	Nephelometric turbidimeter	Nephelometric turbidity units	1-6	*In situ*
	Quantum photometer[c]	μeinsteins/m2/sec photosynehetically available radiation	1-6	*In situ*
Dissolved Oxygen	Membrane electrode method (oxygen meter)	mg/l	1-6	*In situ*
	Iodometric method (Winkler) and modifications	mg/l	1-6	*In situ*
Coliforms	Most probable number technique (MPN)	colonies/100 ml	1-6	1-2 days
	Membrane filter technique		1-6	1-2 days
Nutrients (nitrogen/phosphorus)	Ion chromatography	mg/l in water	1-6	1-2 days
	Wet chemistry method	mg/kg in sediments	1-6	1-2 days
Metals	Atomic absorption spectroscopy (AA) (all metals)	μg/l in water μg/kg in sediments	1-6	2-3 days
	Wet chemistry methods (all metals except barium)		1-6	2-3 days
	Inductively-coupled argon plasma (atomic emission spectroscopy) (ICAP) (all metals except mercury)		1-6	2-3 days
	Ion chromatography (potassium, sodium, iron, copper, nickel, cobalt, zinc, lead, calcium, arsenic and magnesium only)		1-6	2-3 days
Pesticides/PCBs & Hydrocarbons	Gas chromatrography	μg/l in water μg/kg in sediments	5-7	1-2 days
	Gas chromatrography/mass spectroscopy		5-7	1-2 days
	Liquid chromatography		5-7	1-2 days

WATER QUALITY RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	Unit of Measurement	Reference[a]	Time Frame[b]
Oil and Grease	Gravimetric method	mg/l in water mg/kg in sediments	1-6	1-2 days
	Infrared spectroscopy		1-6	1-2 days
Detergents	Colorimetric method (ultraviolet spectroscopy)	mg/l in water mg/kg in sediments	1-6	1-2 days
Sediments	Grain size analyses (mean grain size, sorting coefficient, skewness and Kurtosis of grain size distribution)	phi (Φ) units or µm	6,8,9	2 days
	Elutriate analyses		9-11	3-4 days

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[a] 1) NESP, 1975; 2) States et al., 1978; 3) Henderson, 1982; 4) USEPA, 1979b; 5) APHA, 1980; 6) ASTM, 1983; 7) Federal Register, 1979; 8) Folk, 1974; 9) Pequegnat et al., 1981; 10) USEPA, 1979a; 11) Plumb, 1981.

[b] Time frames are based on estimated laboratory time to complete one analysis. Individual laboratories may require longer processing periods. Field sampling time will vary with individual site conditions.

[c] The techniques do not measure turbidity per se, however, the relative turbidity of two sampling sites may be inferred through use of these techniques.

GROUNDWATER RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	Unit of Measurement	Reference[a]	Time Frame[b]
Nutrients (nitrogen/phosphorus)	Ion chromatography	mg/l	1-6	1-2 days
	Wet chemistry methods			1-2 days
Coliforms	Most probable number technique (MPN)	colonies/100 ml	1-6	1-2 days
	Membrane filter technique			1-2 days
Metals	Atomic absorption spectroscopy (AA) (all metals)	µg/l	1-6	2-3 days
	Wet chemistry methods (all metals except barium)			2-3 days
	Inductively-coupled argon plasma atomic emission spectroscopy (ICAP) (all metals except mercury)			2-3 days
	Ion chromatography (potassium, sodium, iron, copper, nickel, cobalt, zinc, lead, calcium, arsenic and magnesium only)			2-3 days
Pesticides/PCBs	Gas chromatography	µg/l	5-7	1-2 days
	Gas chromatography/mass spectroscopy			1-2 days
	Liquid chromatography			1-2 days
Oil and Grease	Gravimetric method	µg/l	1-6	1-2 days
	Infrared spectroscopy			1-2 days
Detergents	Colorimetric method (ultraviolet spectroscopy)	µg/l	1-6	1-2 days
DATA EVALUATION TECHNIQUES				
Groundwater Contamination	Predictive numerical models	-	8	Several days once all data has been collected
Groundwater field studies	Well monitoring		9-11	

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[a] 1)NESP, 1975; 2)States et al., 1978; 3)Henderson, 1982; 4)USEPA, 1979b; 5)APHA, 1980; 6)ASTM, 1980; 7)Federal Register, 1979; 8)Bachmat et al., 1980; 9)Chow, 1966; 10)Davis and DeWiest, 1966; 11)Soil Conservation Service, 1972.

[b] Time frames are based on estimated laboratory time to complete one test. Individual laboratories may require longer processing periods.

AQUATIC HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame Per Sample[b]
Shellfish Beds	Direct counts (no. of individuals per unit area) or size measurement	1	2-3 days
	Size frequency distribution	2	2-3 days
	Condition index	3,4	3-4 days
	Flow-through or static bioassays	5-9	7-10 days
	Chemical uptake analyses	8-11	4-7 days
	Bacteriological quality analyses	8	3-4 days
Grassbeds	Aerial photography in concert with groundtruthing	12	3-4 days
	Community survey	13-16	3-4 days
	Community productivity	17-21	8-10 days
	1) measured by uptake of radioactive carbon (14C);		
	2) measured by marking the blades and measuring the growth increment after a growth period of several weeks;		7-10 days
	3) measured by statistical estimates based on length and width of the longest 5% of the leaf population of a given area.		3-4 days
Benthos	Numerical assessment (quantitative study)	5,22-25	Sampling could take several days per collection sample processing; analysis may take weeks to months per collection.
	Faunal survey (qualitative study)	22-25	Sampling could take several days per collection. Sample processing may take several weeks per collection.
	Bioassay (effluent or sediment elutriate testing)	5,6,7,9,26,27	Several weeks for collection, testing and data analysis.
Nursery Areas	Numerical assessment (quantitative study)	5,23-25	Sampling could take several days per collection. Sample processing and analysis could take several more weeks per collection.

AQUATIC HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame Per Sample[b]
Nursery Areas (cont'd)	Faunal survey (qualitative study)	22-25	Sampling could take several days per collection. Sample processing could take a few weeks per collection.
	Bioassay (effluent or sediment elutriate testing)	5-7,9,26,27	Several weeks for collection, testing and data analysis.
Manatees	Observation and counts	-	Report observations as they occur.
Sea Turtles	Observation and counts	-	Report observations as they occur.
	Tangle nets	-	Netting conducted daily or weekly in frequented areas
Endangered Species	Presence of other endangered species may be ascertained through the use of previously cited methodology.	-	Report observations and disposition as they occur
	Contact local experts, U.S. Fish and Wildlife, state agencies	Appendix 1	1 or more days
	Reference state and federal endangered species lists	1	1 day

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[a] 1) Van Dolah et al., 1979; 2) Gray et al., 1978; 3) Lawrance and Scott, 1982; 4) Scott and Lawrance, 1982; 5) USEPA, 1973; 6) Cairns and Dickson, 1973; 7) Cairns et al., 1978; 8) NAS, 1980; 9) APHA, 1980; 10) SCDHEC, 1981; 11) Pan et al., 1982; 12) Thompson, 1976; 13) Phillips, 1960; 14) Livingston et al., 1976; 15) McRoy and Helfferich, 1977; 16) Phillips and McRoy, 1979; 17) Patriquin, 1973; 18) Zieman, 1974-75; 19) Penhale, 1975; 20) Capone et al., 1979; 21) Kemp et al., 1981; 22) Holme and McIntyre, 1971); 23) NESP, 1975; 24) USGS, 1977; 25) APHA, 1980; 26) Plumb, 1981; 27) USEPA, 1979b.

[b] Time frames are estimated based on minimal field time and do not include analysis of data collected, unless otherwise specified.

TERRESTRIAL HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Vegetation	Plot, quadrat or transect methods	1-5	4-6 days
	Dry matter production (biomass)	6-9	3-5 days
	Plotless techniques (closest individual, nearest neighbor, random pairs, Bitterlich or quarter methods).	10,11	2-4 days
	Remote sensing (aerial or satellite photography)	12	10-20 days
	Vegetation mapping	6-11	6-8 days
Birds (including rookery areas)	Territory mapping (spot-mapping)	1-11,12-16	8-10 days (in breeding season)
	Roadside count	1-11,12-16	3-4 days (fall and winter)
	Plot method-winter	1-11,12-16	8-10 days (Dec through Feb)
	Strip census	1-11,12-16	3-4 days (seasonally)
	Aerial photos[c]	1-11,12-16	3 days (in winter)
	Aerial visual sample census	1-11,12-16	2-3 days (in spring)
	Nest counts	1-11,12-16	1-2 days (in spring)
	Mark and recapture	16	2 weeks (approximately)
	Auditory index	1-11,12-16	2-12 days (in spring)
	Line transect method (King method)	1-11,12-16	2-3 days (in fall)
	Temporal census	1-11,12-16	1-3 evenings per roost
	Radar	1-11,12-16	several days in migrating season
	Radio-location	1-11,12-16	day and night, all seasons, up to 1 year
Mammals	Drive count (large animals)	1-16	1 day
	Temporal census (large animals)	1-16	2-3 days during migration
	Total capture	1-16	very time consuming; varies with area sampled
	Strip census (King method)	1-16	3-4 days
	Time-Area count	1-16	4-5 days during main activity periods
	Roadside count	1-16	1-2 days
	Bounded count	1-16	10-20 days
	Pellet count	1-16	3-4 days
	Marking	1-16	7-10 days
	Mark and recapture	1-16	8-10 days
	Reduction of rate of capture	1-16	4-5 days
	Selective reduction or increase	1-16	1-2 days per animal

TERRESTRIAL HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Mammals (cont'd)	Radio-telemetry	1-16	up to 1 year
	Infrared scanning (aerial)	1-16	1-2 days
	Aerial photos or counts[c]	1-16	8-10 days
Invertebrates/ Herptiles	Pitfall traps	17-22	2-3 days
	Sweep net collections	17-22	2-3 weeks
	Light trapping	17-22	2-3 weeks
	Malaise trap collecting	17-22	2 weeks
	Drop trap (grasslands)	17-22	2-3 weeks
Soils	Soil mapping (pits, cores, augers)	1-22	3-4 days
	Physical analyses (compaction, porosity, permeability)	1-22	2 days/sample
	Chemical analyses	1-22	2-3 days
	Textural analyses (grain size, soil type, soil description, water content)	1-22	7-10 days
Endangered Species	Presence of endangered species may be ascertained through the use of previously cited methodology	-	-
	Contact local experts, U.S. Fish and Wildlife, state agencies	Appendix 1	1 or more days
	Reference state and federal endangered species lists	-	1 day
Turtle Nesting Areas	Nest counts	-	2-4 days
	Nest removal	-	as necessary
Adjacent Wilderness/ Wildlife Management Areas	Impacts may be inferred from use of previously described techniques	-	-

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[a] 1) NESP, 1975; 2) States et al., 1978; 3) Henderson, 1982; 4) Husch et al., 1972; 5) Odum, 1971; 6) Brown, 1954; 7) Cain and Castro, 1959; 8) Phillips, 1959; 9) Curtis and Cottam, 1962; 10) Greig-Smith, 1964; 11) Ohmann, 1973; 12) Ford, 1979; 13) Franzreb, 1977; 14) Kendeigh, 1944; 15) Parnell and Soots, 1979; 16) Taber and McTaggart-Cowan, 1971; 17) Cochran, 1953; 18) Hanson et al., 1953; 19) Morris, 1960; 20) Southwood et al., 1966; 21) Andrewartha, 1971; 22) ASTM, 1976.

[b] Time frames are estimated based on minimal field time and do not include analysis of data collected unless otherwise specified.

WETLAND HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Vegetation	Plot, quadrat or transect methods	1-11	4-6 days
	Plotless techniques (closest individual, nearest neighbor, random pairs, Bitterlich or quarter methods)	1-11	2-4 days
	Remote sensing (aerial or satellite photography)	12	10-20 days
	Vegetation mapping	6-11	6-8 days
	Dry matter production (biomass)	1-11,26	3-5 days
Soils	Soil mapping (pits, cores, augers)	1,15	3-4 days
	Textural analyses (grain size, soil type, soil description, water content)	1	7-10 days
	Chemical analyses	1,15	2-3 days
	Litter loss rates	13	several days once field data has been collected
	Cellulose decomposition	13	
	Bacteria	14	
	Physical analyses (compaction, porosity, permeability)	1,15	2 days/sample
Erosion	Shoreline profiles	16-18	*in situ*
	Boating activity inventory	16-18	*in situ*
	Electronic wave guage	16-18	*in situ*
	Wind speed gauge and compass	16-18	*in situ*
	Empirical, site specific wind wave energy models	16-18	*in situ* under varying wind conditions
Birds	Aerial photographs	19-24	1-5 days
	Aerial visual sample census	19-24	1 or more days
	Nest counts	19-24	1 or more days
	Mark and recapture	19-24	1 or more days, very time consuming
	Auditory index	19-24	2-4 days
	Temporal census	19-24	1-3 evenings per roost, September
	Radar	19-24	migratory seasons
	Radio-location telemetry	19-24	day and night, all seasons, to 1 year

WETLAND HABITAT RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Mammals	Temporal census	19-24 (see also terrestrial)	2-3 days during migration
	Total capture	19-24	very time consuming; varies with area sampled
	Time-area count	19-24	1 hr/count for several days
	Mark and recapture	25	2 days minimum
	Marking	25	2 days minimum, no specific time
	Reduction of rate of capture	25	2 or more nights
	Selective reduction or increase	25	2 separate samples (1-2 days/animal)
	Radio-telemetry	25	up to 1 year
	Aerial photography/counts	25	8-10 days
Vertebrates/ Invertebrates	Sweep net collections	20-21	2-3 weeks
	Light trapping	20-21	2-3 weeks
	Malaise trapping	20-21	2 weeks
	General collecting	20-21	6-8 days
Endangered Species	Presence of endangered species may be ascertained through the use of previously cited methodology	-	-
	Contact local experts, U.S. Fish and Wildlife, state agencies	Appendix 1	1 or more days
	Reference state and federal endangered species lists	-	1 day

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[a] 1) NESP, 1975; 2) States et al., 1978; 3) Henderson, 1982; 4) Husch et al., 1972; 5) Odum, 1971; 6) Brown, 1954; 7) Cain and Castro, 1959; 8) Phillips, 1959; 9) Curtis and Cottam, 1962; 10) Greig-Smith, 1964; 11) Ohmann, 1973; 12) Ford, 1979; 13) Phillipson, 1970; 14) Parkinson et al., 1971; 15) ASTM, 1976; 16) Zabawa and Ostrom, 1980; 17) Sverdrup and Munk, 1947; 18) USACOE, 1973; 19) Kendeigh, 1944; 20) Giles, 1971; 21) NESP, 1975; 22) Franzreb, 1977; 23) Parnell and Scots, 1979; 24) States et al., 1978; 25) Taber and McTaggart-Cowan, 1971; 26) Kibby et al., 1980.

[b] Time frames are estimated based on minimal field time and do not include analysis of data collected unless other wise specified.

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SOCIOECONOMIC RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Cultural Historical	Reference the National Register of Historic Places	-	1 day
	Interview local collectors	-	2-3 days
	Contact appropriate State Historic Preservation Officer	(Appen 1)	1 day
Archaeological	Reference the National Register of Historic Places	-	1 day
	Interview local collectors	-	2-3 days
	Contact appropriate State Historic Preservation Officer	(Appen 1)	1 day
	Archaeologicl Survey: Surface reconnaissance	1,2	several weeks for collection, testing and data analysis
	Excavation	1,2	
	Laboratory analysis of artifacts	1,2	
Economic Resources/ Land Use	*Contact local Planning Board	-	1 day
	*Review existing mapped data	5	1-2 days
	*Visual site survey	-	1-2 days
	Aerial reconnaissance	4	1-2 weeks
	Comparative cost analysis	1	Several weeks for collection, data analysis
	Input-output analysis	1,6-8	Several weeks for collection, data analysis
	Spatial interaction analysis (The gravity model)	1	Several weeks for collection, data analysis
	Activity complex analysis	1	Several weeks for collection, data analysis
	Numerical ecological classification system	1	Several weeks for collection, data analysis

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[a] 1)Henderson, 1982; 2)Willey, 1966; 3)Isard, 1972; 4)Ford, 1979; 5)U.S. Coast and Geodetic Survey Charts; 6)Nelson et al., 1980; 7)Crompton and Ditton, 1975; 8)Nissan and Williams, 1980.

[b] Time frame dependent upon availability of data, personnel.

AESTHETIC RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	Unit of Measurement	Reference[a]	Time Frame[b]
Visual	Data Collection Techniques:			
	Systematic observer survey	-	1,2	*In situ*
	Eye-level photography	-	1,2	*In situ*
	Written record of visual impressions	-	1,2	*In situ*
	Remote sensing[c]	-	1-3	10 days
	Mapping	-	1,2	1 or more days
	Evaluation Methods:			
	Qualitative Classification schemes	-	1,4	1 or more days
	Quantitative			
	Independent	-	5-7	1 or more days
	Comprehensive	-	8-11	1 or more days
Noise	Precision sound level meters	Sound level (L) in decibels (dB)	12,13	*in situ*
	Vibration meters		12,13	*in situ*
	Recorders		12,13	*in situ*
	Computer modeling and analytical techniques		14	several days once all data has been collected
Taste	Taste threshold test performed by panel	Rating system	15	1 day
Odor	Threshold odor test performed by odor judgement panel	Rating system	15	*In situ*
	Scentometer		15	*in situ*

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[a] 1) Roy Mann Associates, Inc., 1975; 2) Henderson, 1982; 3) Ford, 1979; 4) Litton et al., 1974; 5) Burnham, 1974; 6) Sargent, 1967; 7) Leopold, 1969; 8) Leopold, 1971; 9) Dee, 1972; 10) Shafer and Mietz, 1970; 11) Golden et al., 1979; 12) Peterson and Gross, 1974; 13) Englund and Berry, 1974; 14) USEPA, 1978; 15) Jain, et al., 1974.

[b] Time frames dependent upon availability of data, personnel.

NAVIGATION RESOURCES
MEASUREMENT TECHNIQUES

Impact	Assessment Technique	References[a]	Time Frame[b]
Circulation	Dye and drogue studies/ field observations	1-3,5	*in situ*
	Aerial photography/ground-truthing	4,7	10 days
	Hydrographic study	6	Several days once all data has been collected
Wave Conditions	Field observations	-	*in situ*
	Wave ray tracing	8	2-3 days
	Refraction and diffraction diagram analysis	9,10	1-2 days
	Hydraulic modeling	10	Several days once all data has been collected
Other Physical Factors	Analyze available data	-	Several days once all data has been collected
	Interview local residents	-	*in situ*
	Diver observation	-	*in situ*
Soils/Sediments	Soil investigations - test piles - direct soil evaluation	11,12	2 days 2 days
Depth	Soundings	6	*in situ*
Wind Direction/ Velocity	Anemometer	-	*in situ*

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[a] 1)Feverstein and Selleck, 1963; 2)Wilson, 1968; 3)Scott et al., 1969; 4)Ford, 1979; 5) Marcus and Swearingen, 1983; 6)U.S. Coast and Geodetic Survey Charts; 7)Blades, 1982; 8)Kinsman et al., 1979; 9)ASCE, 1969; 10)Zabawa and Ostrom, 1980; 11)Plumb, 1981; 12)USEPA, 1979b

[b] Time frame dependent upon availability of data, personnel.

APPENDIX B

SLIP-SIDE WASTEWATER COLLECTION SYSTEMS

ASSUMPTIONS AND COSTING EXAMPLES

TABLE B-1

ASSUMPTIONS MADE FOR COSTING SYSTEMS

1. SLIP-SIDE SERVICE

   a. Marina design and layout based on information set forth in Marinas: Recommendations for design construction and management by Clinton J. Chamberlain, NMMA, 1983

   b. Costs of PVC Schedule 40 pipe 2" $1.50/ft
      3" $2.75/ft
      4" $3.90/ft

   c. Installation cost of pipe is equal to capital cost of pipe

   d. One vacuum central unit can serve 300 slips and includes two vacuum pumps and two sewage pumps

   e. "Typical" example marina includes 10% liveaboards

   f. Installation of vacuum central unit estimated at 20% of capital costs

   g. A vacuum central unit is capable of serving 300 slips

   h. Annualized costs based on 15 year life cycle and 12% interest

   i. Power costs based on $0.08/KWHR

   j. Miscellaneous maintenance costs are equal to 5% of vacuum central costs

   k. Major maintenance is equal to 25% of vacuum central costs per 5 years

   l. Assume one vacuum central unit requires ¼ of a man for O & M

   m. Costs for public wastewater collection/conveyance and treatment not included in any analysis

   n. Costs to boat owners for fit or retrofit with MSD's not included/ considered in discussions

   o. Contingencies of 10% of added to costs of system

TABLE B-1 (Cont'd.)

2. MARINA WIDE SYSTEMS
    a. Assumptions include: a, b, c, e, h. i, m, n, o (from item 1)
    b. Miscellaneous maintenance equal to 5% of capital costs
    c. Major maintenance is equal to 25% of capitl costs every 5 years
    d. Every other pier has a pump-out facility
    e. Installation of pump-out is equal to 20% of equipment costs
3. PORTABLE/MOBILE SYSTEMS
    a. Assumptions include: a, b, c, e, i, m, n, o (from item 1)
    b. Annualized costs based on 12% and 15 years on piping and 12% and 5 years on pumping units
    c. One person with portable unit can perform 4 pump-outs/hour
    d. Shifts assumed to be 10 hours/day, 5 days/week
    e. Regular cruising vessel requires one pump-out per week
    f. Liveaboard vessel requires pump-out every other day
    g. Labor includes 30% benefit package

TABLE B-2

COST ESTIMATE FOR
SLIP-SIDE SERVICE

A. CALCULATE TOTAL LENGTH OF MAIN PIERS

Number of Piers	x	Length	=	Total (feet)
____		____		____
____		____		____
____		____		____
____		____		____
____		____		____

A1 ____

A2 ____

B. CALCULATE PIPING LENGTH ALONG FINGER PIERS

Number	x	Length	=	Actual	x	2 (for double wide slips)	=	Pipe Length (feet)
____		____		____		____		____
____		____		____		____		____
____		____		____		____		____
____		____		____		____		____
____		____		____		____		____

Total

B1 ____

C. CALCULATE INTER-PIER (ONSHORE) PIPING

Number of Piers (A1 above) x Length of Longest finger pier (ft) x 3.5 Length (ft)

____ ____

Total

C1 ____

TABLE B-2 (Cont'd.)

D. CALCULATE PIPING COSTS

	Length	x	Cost/foot	=	Total Cost
A2	______		________		_________
B1	______		________		_________
C1	______		________		_________
	Total			D1	_________

E. INSTALLATION COST (100% of Line D1)

Total E1 _________

F. TOTAL PIPING COSTS

D1 + E1 = F1 _________

G. DETERMINE:

G1 Number of slips ______

G2 Number of livaboards ______

G3 Number of fueling piers ____

H. CALCULATE VACUUM SYSTEM COSTS

Line G1 ÷ 300(1) =

X

Cost/Vac. Central Module _________

Total Cost of Modules H1 _________

I. CALCULATE INTERFACE VALVE COST

Single Interface Valve: [(Line G1 - Line G2) - 4] x $/Valve = ________

Automatic Interface Valve: (Line G2) x $/valve = ________

Single (Transient Vessel) Interface
Valve: (Line G3) x $/Valve = ________

Total Cost of Valves I1 ________

(1) Assume 300 slips/central vacuum module.

TABLE B-2 (Cont'd.)

J. EQUIPMENT INSTALLATION COST (H1 + I1)(0.20) = __________

Total Installation Cost J1 __________

K. TOTAL SLIP-SIDE VACUUM SYSTEM COST

F1 _____ **+ H1** _____ **+ I1** _____ **+ J1** _____ **=** __________

Total Cost K1 __________

TABLE B-3

COST ESTIMATE FOR
MARINA WIDE SERVICE

A. CACULATE TOTAL NUMBER OF PIERS AND DIVIDE BY TWO

A1__________ ÷ 2 = A2__________

B. CALCULATE TOTAL PIPING LENGTH ALONG PUMP OUT PIER

Length

______

______

______

______

______

______

Total B1 ______

C. CALCULATE TOTAL INTERIOR (ON-SHORE) PIPING

Number of Piers (Line A1)	x	Length of Longest Finger Pier (ft) x 3.5		
________	x	______	x 3.5	=

Total C1 _______

D. CALCULATE PIPING COSTS

	Length	x	Cost/ft	=	Total Cost
B1	______	x	______	=	______
C1	______	x	______	=	______
			Total D1	=	______

E. INSTALLATION COSTS (100% of Line D1)

Total E1 _______

TABLE B-3 (Cont'd.)

F. TOTAL PIPING COSTS

D1 ______ + E1 ______ = F1 ______

G. COST OF PUMP-OUT EQUIPMENT:

Number of Pump-outs Line A2 x Cost Per Unit =

Total G1 ______

I. INSTALLATION OF PUMP-OUT EQUIPMENT

Line G1 ______ x 0.2 =

Total I1 ______

J. TOTAL MARINA WIDE PUMP-OUT COSTS

F1 ______ + G1 ______ + H1 ______ =

Total J1 ______

TABLE B-4

COST ESTIMATE FOR PORTABLE/MOBILE SYSTEM

A. DETERMINE NO. OF PUMP-OUTS REQUIRED PER DAY

Regular Slips ______ x $\frac{\text{one pump-out}}{\text{week}}$ x $\frac{\text{week}}{\text{5 days}}$ =

Subtotal A1 ______

Liveaboard Slips ______ x $\frac{\text{4 pump-outs}}{\text{week}}$ x $\frac{\text{week}}{\text{5 days}}$

Subtotal A2 ______

Total A1 + A2 A3 ______

B. DETERMINE UNITS REQUIRED

Line A3 ______ $\frac{\text{40 pump-outs}}{\text{day}}$ =

Total B1 ______

C. UNIT COSTS

Line B1 ______ + 1 (standby unit) x Cost/Unit =

Total C1 ______

D. DETERMINE PIPING COSTS (ON-SHORE) PORTABLE UNIT PUMPS TO COLLECTION LINE ON SHORE

Total Number of Piers ______ x Length of Longest Finger Pier (ft) x 3.5

Total D1 ______

E. PIPE INSTALLATION COST

100% of Line D1

Total E1 ______

F. TOTAL PORTABLE/MOBILE COSTS

Line C1 ______ + Line D1 ______ + Line E1 ______ =

Total F1 ______

APPENDIX C

CONTROLLED PURIFICATION OF SHELLFISH

Shellfish are particularly sensitive resources with respect to marina development because of the potential for fecal bacteria contamination from marinas and boat discharges. Shellfish will cleanse themselves of polluting microorganisms and other substances over a period of time if they are provided with clean water.

The U.S. Food and Drug Administration (FDA) recognizes two cleansing methods. One method, referred to as relaying, involves transferring shellfish from a restricted or prohibited growing area to one that meets approved growing water standards. These shellfish must remain in approved waters for at least 14 days before being reharvested. The second method, referred to as controlled purification or depuration, involves the process of self-cleansing in an onshore facility, a depuration plant, where water quality can be controlled. In most instances, water taken from a nearby estuary is disinfected in a depuration plant by ozonation or ultraviolet irradiation. The water then flows through tanks containing the shellfish and is returned to the estuary. The depuration process requires approximately 48 to 72 hours. Complete depuration must be confirmed by required bacteriological testing (Williams, et al., 1980; FDA, DRAFT; Furfari, 1966).

Shellfish purification methods are technically proven processes that allow harvesting of shellfish from most of the coastal waters but should not be considered substitutes for adequate pollution control. Each method has advantages and disadvantages related to technical application, economics, institutional concerns, and environmental characteristics. In general, the methods and principles discussed are valid for all shellfish but the specifics and details of purification could vary significantly.

Depuration (Controlled Purification)

Commercial depuration of shellfish has been successfully practiced in Great Britain and other European countries for over 60 years. In fact, the majority of marketable oysters in England and Wales are subject to a purification process. By contrast, depuration has been sporadically practiced in the United States. Clam depuration plants are located in Maine, Massachusetts, New York, New Jersey, South Carolina, Florida and California (Table C-1). The only existing oyster depuration plant in the United States is a land based aquaculture facility in Hawaii which grows the Pacific oyster. One oyster depuration plant, currently scheduled for construction in Louisiana, will have a capacity of approximately 1,000 bushels per day (Casper, 1984). The limited use of controlled purification is not clearly understood since many oyster beds throughout the United States are closed for harvest due to moderate pollution.

There are many factors to consider in constructing and operating a depuration facility. The typical depuration plant is comprised of four units: 1) controlled dry storage for untreated and treated shellfish, 2) washing and culling facilities for untreated and treated shellfish, 3) depuration tanks or basins and 4) seawater treatment (Figure C-1). Depending on the facility, office and laboratory space may be necessary. Conveyer belts or overhead traveling cranes and hoists for lifting large loads of shellfish may be needed for large plants (Furfari, 1966).

TABLE C-1

DEPURATION PLANTS OPERATIONAL IN THE USA AS OF JULY 1983

State	Number	Type
Maine	3	Soft Clam
Massachusetts	1	Soft Clam
New York	1	Hard Clam
New Jersey	2	Soft Clam
South Carolina	5	Hard Clam
Florida	1	Hard Clam
California	1	French Oyster (12/82 Inactive)
Hawaii	1	Pacific Oyster (3/83 Inactive)

SOURCE: Furfari, 1983 (unpublished)

The site of a shellfish purification plant is of primary importance. Factors to be considered include a suitable supply of seawater, accessibility by vehicle and/or boat, availability of utility services such as electricity, and water and waste disposal. The pollution status of a water source is critical to the depuraton process. The two most economical sources of seawater are a well supply or local high quality surface supply. The quality of source seawater required is outlined in Table C-2, along with major environmental factors important in the depuration of shellfish to acceptable levels. These environmental factors include temperature, turbidity, salinity, dissolved oxygen, flow rate, pH, and the concentration of pollutants in the depuration waters. Brief descriptions of these factors follow; more information is available from Furfari (1966, 1976) and Bond and Truax (1978).

- Temperature affects the activity of shellfish. Low temperatures generally cause hibernation and inactivity; higher temperatures may induce spawning of ripe oysters which could cause operational problems.

- Excessive turbidity can reduce shellfish feeding activity, reduce the penetrating power of ultraviolet light, cause an undesirable taste in shellfish, and cause maintenance problems.

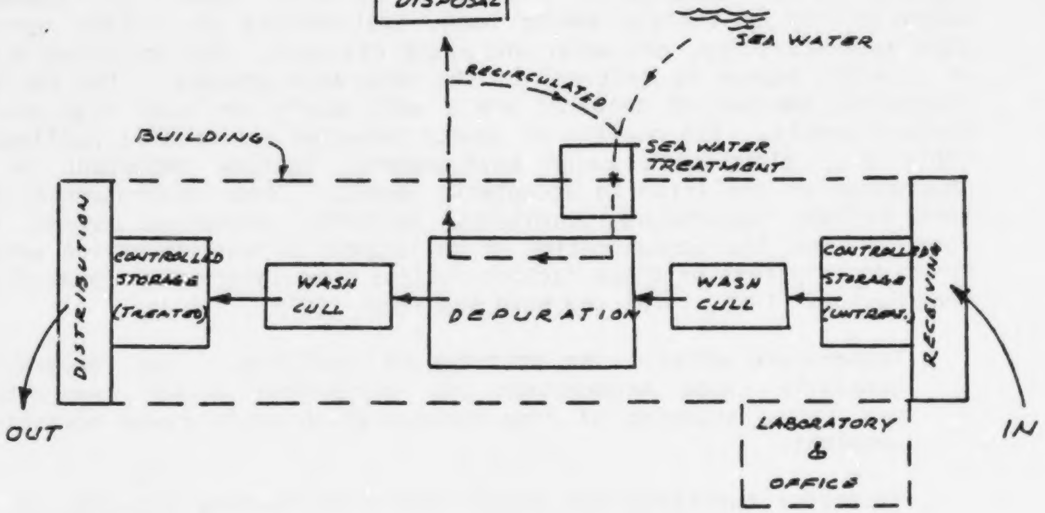
- Reduction of salinity to a level of 50 to 60 percent of the oysters' natural environment was found to stop shellfish from functioning. Variations within ± 20 percent of those conditions found in the harvest area have a minimum influence on the cleansing process.

- Dissolved oxygen levels in depuration waters are reported to be important because below 2.55 cc/liter (3.6 mg/liter) the oxygen consumption of *C. virginica* becomes restricted.

- Flow rates are directly related to the degree of oxygen depletion. The greater the flow rate the more oxygen provided to the shellfish and the lower the rate of depletion. A flow rate of 1 liter/oyster/hour is recommended.

- Oyster depuration will occur between pH values of 7.0 and 8.4 units.

- Pollution in the form of metals and some organics can be concentrated by shellfish. Additionally, shellfish concentrate microorganisms of which pathogens are a problem. The inactivation of microorganisms in seawater has been accomplished by several means, including chlorination, ultraviolet light treatment, ozonation and heating.


DISPOSAL
SEA WATER
RECIRCULATED
BUILDING
SEA WATER TREATMENT
DISTRIBUTION
CONTROLLED STORAGE (TREATED)
WASH CULL
DEPURATION
WASH CULL
CONTROLLED STORAGE (UNTREAT.)
RECEIVING
OUT
LABORATORY & OFFICE
IN

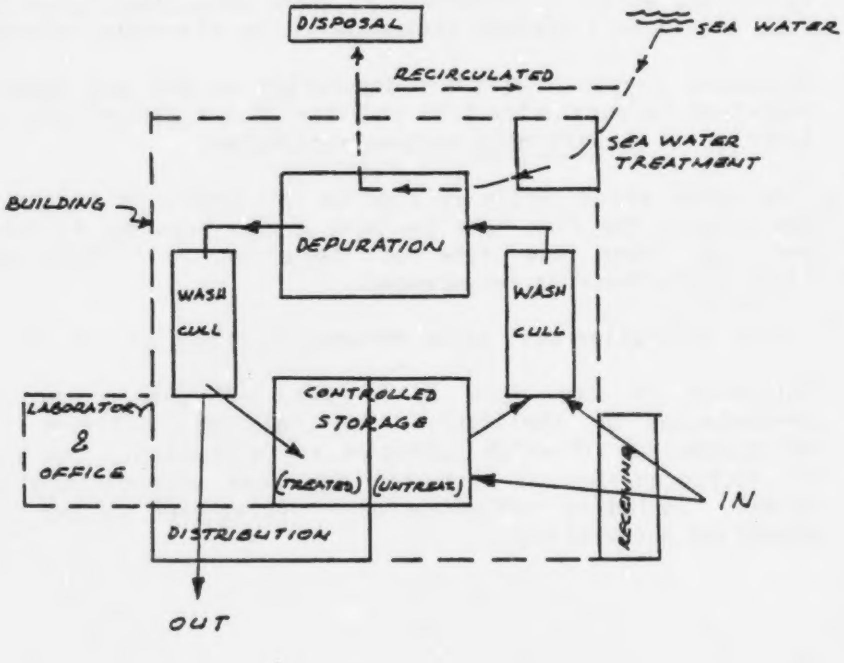

DISPOSAL
SEA WATER
RECIRCULATED
SEA WATER TREATMENT
BUILDING
DEPURATION
WASH CULL
WASH CULL
CONTROLLED STORAGE
LABORATORY & OFFICE
(TREATED)
(UNTREAT.)
RECEIVING
IN
DISTRIBUTION
OUT

Figure C-1. Depuration plant layouts (Furfari, 1966).

TABLE C-2

QUALITY OF DEPURATION SOURCE WATER (SEAWATER)

Item		Limits Minimum	 Maximum	Control Methods
Temperaure[b]:	Soft Clam	35°F(2°C)	68°F(20°C)	Incorporate water temperature control device into depuration facility
	Hard Clam	50°F(10°C)	68°F(20°C)	
	Oyster	50°F(10°C)	77°F(25°C)	
Turbidity[b]		----	20 Jackson Candle Turbidity Units	Reduce turbidity by settling, filtration, and centrifugation. Care must be given not to remove food particles from depuration waters
pH		7.0	8.4	Raise or lower artifically
Salinity[b]		within (100±20) % percent of the harvest area value		Locate plant in vicinity of harvest area. Dilute high salinity seawater with freshwater. Use artificial seawater[c]
Oxygen		5.0 mg/l	Saturation[a] temperature	Elevate D.O. by diffused aeration or cascade aeration
Metallic Ions and Compounds		Potentially toxic metals shall not be in concentrations above that normally found in seawater		Treatments to remove these elements and compounds typically too expensive and difficult to control
Organics, Radioisotopes and Marine Toxins		Pesticides, detergents, dye stuffs, radioisotopes and marine toxins shall not be in concentrations in water above that which can cause concentrations in shellfish which are unacceptable by FDA regulations. Paralytic shellfish poison: 80 micrograms per 100 grams of the edible portion		Treatments to remove these elements and compounds typically too expensive and difficult to control

TABLE C-2
(continued)
QUALITY OF DEPURATION SOURCE WATER (SEAWATER)

Item	Limits Minimum	 Maximum	Control Methods
Coliform MPN/100 ml:			
Depuration Seawater	----	1.0	Bactericidal treatment such as ozone or untraviolet light
Source Seawater	Median of samples equal to or less than 700 (not more than 10 percent of samples shall exceed 2300 for a 5-tube, 3-dilution test, and 3300 for a 3-tube, 3-dilution test)		
Flow rate	one gallon/min/bushel		

---

[a] Adapted from Furfari, 1966 and Bond and Truax, 1978

[b] Subject to geographical and local differences. For example, Gulf Coast oysters may depurate just as effectively at 28°C as at 25°C, and at turbidities up to 100 JTU.

[c] According to Furfari (1976) the depuration plants in the United States did not require salinity adjustments

Treatment of the seawater to meet the quality standards outlined in Table C-2 may or may not be necessary. However, in order to maintain sanitary conditions and to assure that the water used in purification is not contaminated, treatment for microbiological contamination is necessary. The two most widely used techniques for reducing bacterial and viral populations of waters are ultraviolet (UV) irradiation and ozonation. Ozone is used in France and Spain and UV light is used in the United Kingdom and United States in commercial plants. The effectiveness of using these methods has been well documented (Furfari 1966,1976; Bond and Truax 1978; Williams et al., 1980).

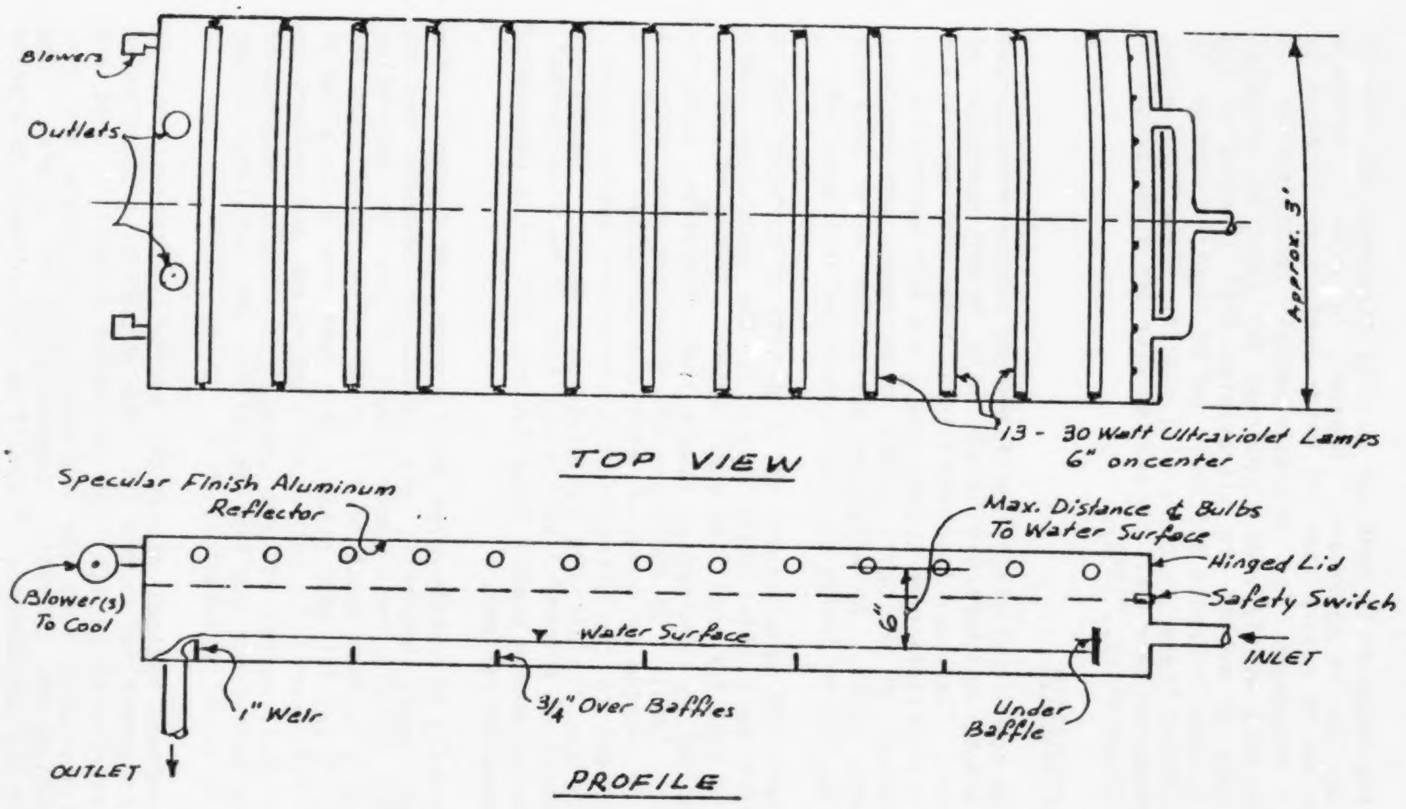
Ultraviolet Irradiation

Relatively high concentrations of coliforms and various viruses have been reduced to almost undetectable levels with proper operation of ultraviolet treatment. There are four operational items pertinent to the use of the ultraviolet disinfection system; these are bulb monitoring and replacement, maintenance of the unit, safety of personnel and equipment reliability (Furfari, 1966). An effective ultraviolet water treatment unit developed by the Public Health Service is depicted in Figure C-2.

Ultraviolet lamps are manufactured for a variety of purposes but it is only those which emit ultraviolet light in the germicidal range (2,537Å) that may be used for shellfish purification. A dose of approximately 7,000 μw-sec/cm^2 is required to assure that viruses and bacteria will be killed (FDA, 1983). In addition, the effective penetration of ultraviolet light is limited by depth of water and turbidity. Turbidity is the major deterrent to the ultraviolet disinfection system because excessive turbidity can inhibit the disinfection process. Additional facilities for removal of suspended solids may have to be incorporated, depending on the water source used. These factors need to be considered in the design of seawater systems.

There are currently no standardized purification tank designs in the United States, but basic hydraulic and sanitation concepts may be followed. The FDA (DRAFT) recommended specifications for depuration tanks would provide a maximum depth of 7.6 cm (3 in) for hard clams and oysters and 20.3 m (8 in) for soft clams. This tank size would allow at least $0.224m^3$ (8 ft^3) per U.S. bushel of hard clams and oysters or $0.14m^3$ (5 ft^3) per U.S. bushel of soft clams. It is also recommended that hydraulic flow throughout the tank be uniform and turbulence in the tank be minimized to avoid recontamination of the shellfish.

The other treatment method, ozonation, typically does not require additional water treatment for turbidity. The germicidal properties of ozone have been attributed to its high oxidation potential (Bond and Truax, 1978). By-products from the decomposition of ozone are also effective in reducing the microbial concentration of waters. The limiting factor in the maintenance of shellfish in a closed depuration system is nitrogeneous waste accumulation. Ozone reactions with various nitrogen compounds are complex and influenced by the characteristics of the water being treated (i.e., pH, temperature, concentration of com-


Blowers
Outlets
Approx. 3'
13 - 30 Watt Ultraviolet Lamps
6" on center
TOP VIEW
Specular Finish Aluminum Reflector
Max. Distance ℄ Bulbs To Water Surface
Hinged Lid
Safety Switch
6"
Blower(s) To Cool
Water Surface
INLET
1" Weir
3/4" Over Baffles
Under Baffle
OUTLET
PROFILE

NOTES:
1. Since U.V. Bulbs absorb U.V. radiation minimum recommended spacing is 4"
2. Parabolic reflectors over each bulb will increase efficiency.
3 Unit must be level.
4. Ground the electrical system.

Figure C-2. Ultraviolet treatment unit for sea water developed by the Public Health Service at Purdy, Washington (Furfari, 1966).

peting compounds, etc.). However, the end product of those reactions appears to be nitrate (Bond and Truax, 1978). Nitrates are reported to be least toxic with regard to shellfish activity, with levels as high as 100 ppm showing no effect on metabolic processes. The use of ozone requires careful control because excessive ozone concentrations may weaken or kill oysters. Ozone generators also require auxiliary equipment such as blowers, piping and filters (Furfari, 1966). An example of an ozone treatment unit is depicted in Figure C-3.

Regardless of the depuration method selected, ozonation or ultraviolet irradiation, a period of 48 to 72 hours is required for the purification process to be considered complete. If polluted shellfish are added to a batch which has already received partial purification then another 48 hour period of purification must be completed before any shellfish may be marketed. The time required for depuration is a function of the environmental conditions in the depuration system, the initial bacterial level in the shellfish and the final bacterial levels desired. Source and process seawater are therefore tested daily for critical parameters and to demonstrate that treatment units are working properly.

The basic premise for public health assurance is that depurated shellfish harvested from restricted areas should attain the same low bacterial levels of shellfish harvested from approved or conditionally approved areas. Generally, the shellfish harvested from waters in the range of 70-200 coliform MPN/100 ml need to be depurated for 48 hours; those from waters in the range of 200-700 coliform MPN/100 ml need to be depurated for 72 hours. Shellfish harvested from waters containing more than 700/100 ml coliform are considered unacceptable for depuration (Furfari, 1966).

The National Shellfish Sanitation Program (NSSP) final product criteria for soft shelled clams (Mya arenaria) is a median of 50 fecal coliforms per 100 grams of meat or less and not more than 10 percent of the samples exceeding 170 fecal coliform per 100 grams (FDA, DRAFT). NSSP guidelines state that hard clams and oysters can be purified to a median of 20 fecal coliform per 100 grams and not more than 10 percent of the samples exceeding 70 fecal coliform per 100 grams (FDA, DRAFT). NSSP purification requirements are further discussed in the Institutional Section.

Relaying

Shellfish relaying, the movement of shellfish from polluted waters to cleaner waters for purging and later reharvesting, is another potential solution to loss of shellfish resources from required closures. In relaying operations, shellfish are harvested from marginally polluted areas onto boat decks or packed in bags, plastic crates or baskets. Shellfish are then transported to specially approved sites and flushed off the decks into the water by high velocity hoses, or the bags and/or crates containing the shellfish are lowered by ropes to the estuary bottom. Baskets may be placed on rocky foreshores, supported by racks on

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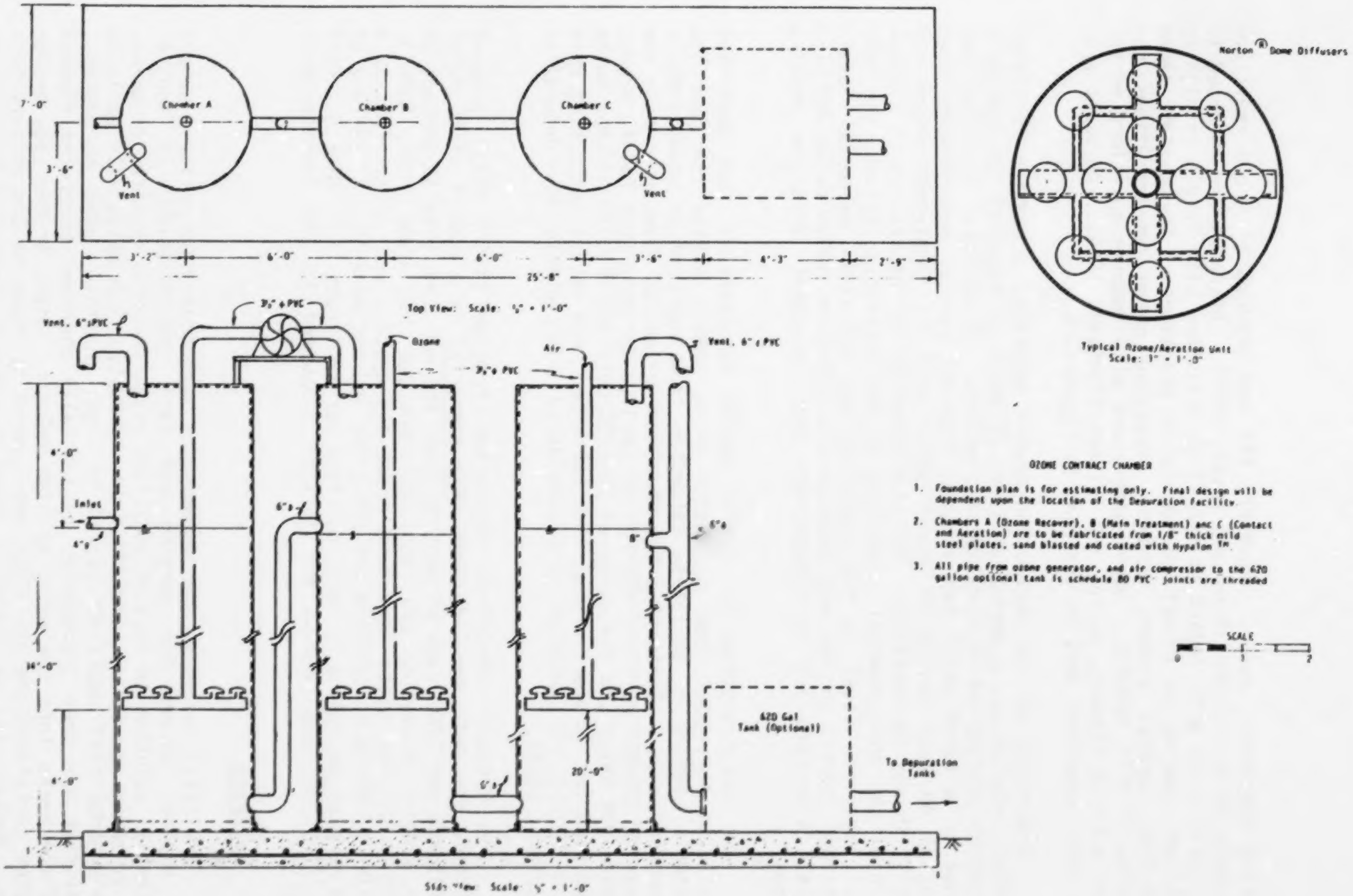

Chamber A
Chamber B
Chamber C
Vent
Vent
7'-0"
3'-6"
3'-2"
6'-0"
6'-0"
3'-6"
4'-3"
2'-9"
25'-8"
Top View: Scale: ⅛" = 1'-0"
Vent, 6" ⌀ PVC
3½" ⌀ PVC
Ozone
3½" ⌀ PVC
Air
Vent, 6" ⌀ PVC
Inlet
4" ⌀
6" ⌀
6" ⌀
5" ⌀
8"
4'-0"
14'-0"
4'-0"
1'-0"
20'-0"
620 Gal
Tank (Optional)
To Depuration
Tanks
Side View Scale: ⅛" = 1'-0"
Norton ® Dome Diffusers
Typical Ozone/Aeration Unit
Scale: 1" = 1'-0"
SCALE
0
1
2

OZONE CONTRACT CHAMBER

1. Foundation plan is for estimating only. Final design will be dependent upon the location of the Depuration Facility.

2. Chambers A (Ozone Recover), B (Main Treatment) anc C (Contact and Aeration) are to be fabricated from 1/8" thick mild steel plates, sand blasted and coated with Hypalon TM.

3. All pipe from ozone generator, and air compressor to the 620 gallon optional tank is schedule 80 PVC joints are threaded

Figure C-3. Example of ozone treatment unit (Bond and Truax, 1978).

soft beaches, suspended from rafts, or attached to floated lines for easier recovery. Basket purification also may be used as an additional step by depuration facilities to ensure reasonable purification time and also as a means to maintain continuity and uniformity of supply.

Relaying from restricted or prohibited areas to approved areas is allowed by state shellfish control agencies subject to certain limitations. Relaying operations are carried out by state agencies, private interests, or joint ventures between state transplanters and private operators/shippers. All relaying operations must be under the immediate supervision of the shellfish control agency.

Like controlled purification, the cleansing process depends on the pumping activity of the shellfish which is controlled by environmental factors such as water quality, temperature, salinity, turbidity, size and the presence of organic and inorganic materials. Temperature is a critical factor since the rate of purging appears to be negatively related to water temperature. The lower the water temperatures (perhaps bounded, however), the shorter period of time needed for successful purging (Easley and Seabolt, 1981). However, viruses are not eliminated at the same rate as bacteria. Current NSSP practice among the states is to require a minimum purification time of 14 days. This period of time is sufficient to allow all shellfish in a population to cleanse themselves of polluting microorganisms if environmental factors are favorable for oyster or other shellfish activity.

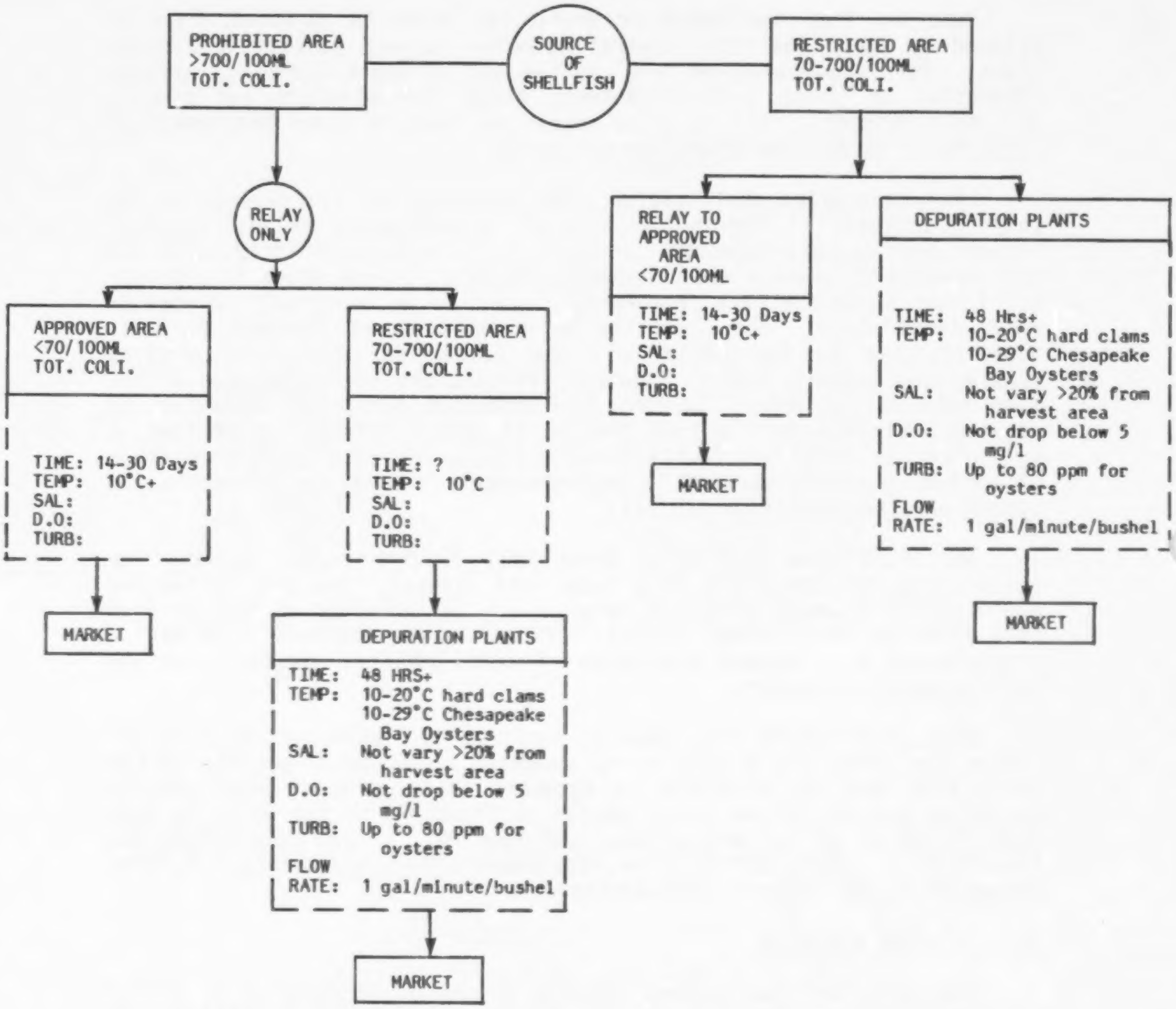
Shellfish from prohibited areas will require longer periods for purification if they are heavily laden with viruses. The time period for purification by means of basket relaying may be shortened to four or five days based on local study results. However, this shortened time period necessitates more intense monitoring of water quality, the shellfish and environmental parameters.

NSSP purification requirements, outlined in Figure C-4, must be met before shellfish are allowed to be marketed. The water quality in the relay area must be monitored to document that approved water quality standards are maintained (i.e., median coliform MPN of the water is less than 70/100 ml or the median fecal coliform MPN is less than 14/100 ml; FDA, DRAFT). NSSP purification requirements for relaying are further discussed in the Institutional Section.

INSTITUTIONAL ANALYSIS

The rules and regulations relating to the utilization of shellfish harvested from restricted areas vary from state to state in USEPA Region IV. While all USEPA Region IV states have written policies concerning relaying, depuration policies apparently are not as well defined, since only two states (South Carolina and Florida) have operational facilities. Many of the states have recently reviewed or are currently reviewing state policies concerning depuration and/or relaying. The USEPA Region IV states with written depuration and relaying policies generally follow the guidelines established by the National Shellfish Sanitation Program

NSSP PURIFICATION REQUIREMENTS


PROHIBITED AREA
>700/100ML
TOT. COLI.
SOURCE OF SHELLFISH
RESTRICTED AREA
70-700/100ML
TOT. COLI.
RELAY ONLY
APPROVED AREA
<70/100ML
TOT. COLI.
TIME: 14-30 Days
TEMP: 10°C+
SAL:
D.O:
TURB:
MARKET
RESTRICTED AREA
70-700/100ML
TOT. COLI.
TIME: ?
TEMP: 10°C
SAL:
D.O:
TURB:
DEPURATION PLANTS
TIME: 48 HRS+
TEMP: 10-20°C hard clams
10-29°C Chesapeake Bay Oysters
SAL: Not vary >20% from harvest area
D.O: Not drop below 5 mg/l
TURB: Up to 80 ppm for oysters
FLOW RATE: 1 gal/minute/bushel
MARKET
RELAY TO APPROVED AREA
<70/100ML
TIME: 14-30 Days
TEMP: 10°C+
SAL:
D.O:
TURB:
MARKET
DEPURATION PLANTS
TIME: 48 Hrs+
TEMP: 10-20°C hard clams
10-29°C Chesapeake Bay Oysters
SAL: Not vary >20% from harvest area
D.O: Not drop below 5 mg/l
TURB: Up to 80 ppm for oysters
FLOW RATE: 1 gal/minute/bushel
MARKET

Depuration shall be permitted only under the immediate supervision of the appropriate state shellfish control agency.

Abstracted from FDA, 1983.

Figure C-4. Purification requirements of the National Shellfish Sanitation Program (adapted from FDA, 1983).

(NSSP), a cooperative association between the states, the Food and Drug Administration (FDA) and the shellfish industry. The NSSP's basic program document, the 1965 Manual of Operations, is currently being updated and is referred to in the text as FDA, DRAFT. Relaying and depuration regulations continue to be developed in response to increased commercial interest in their use.

The states, supervised by FDA, are responsible for providing laws or regulations to ensure the sanitary control of all interstate phases of the shellfish industry, including relaying and depuration. State procedures related to relaying and depuration include sanitary surveys of growing areas. Each growing area is designated as approved, conditionally approved (optional), restricted (optional), or prohibited. The states may alternatively classify conditionally approved and restricted areas as prohibited if technical and administrative resources are insufficient for surveying, monitoring and controlled harvesting. Areas in which sanitary surveys have not been performed are automatically classified as prohibited. The classifications are summarized below.

	Median total coliform standard	Median fecal coliform standard
Approved	< 70 MPN/100 ml nmt 10% of samples >230/100 ml for 5-tube decimal dilution test	<14 MPN/100 ml nmt 10% of samples >43 MPN/100 ml
Prohibited	>700 MPN/100 ml >10% of samples >2300/100ml	>140/100 ml >10% of samples >430 MPN/100 ml

State shellfish control agencies (SSCA) may approve the transfer or relay of market shellfish from restricted or prohibited areas to approved areas for purification if certain conditions are met. Those conditions as outlined in the current NSSP Manual, are summarized in Table C-3. Shellfish from restricted areas may be marketed after effective controlled purification (depuration). Controlled depuration of shellfish harvested directly from prohibited areas is not permitted. Table C-4 summarizes the guidelines for shellfish depuration facilities.

TABLE C-3

NSSP RELAY PURIFICATION REQUIREMENTS

- State control agency provides or approves written operating procedures.

- Harvestor possesses a valid permit or license to relay issued by the SSCA. The license may be renewed annually or per relay operation.

- SSCA provides supervision for harvest, transport, and laying down of the shellfish.

- Shellfish for relay shall not be contaminated with heavy metals, hydrocarbons, toxic chemicals or radionuclides to the extent that they may not be removed during relaying.

- Designated relay areas are located and marked for ready identification and so that any adjacent approved areas will not be contaminated.

- Shellfish shall not be relaid for less than 14 days under suitable conditions for purification.

- Relaid shellfish are harvested only with writen permission of SSCA.

- Adequate records are maintained by the private relay harvestor/operator. (Test results, date of harvest, stock source, quantity, etc.)

- Adequate records are maintained by SSCA for each relay operation.

- Container (basket) relaying is subjected to the same type of controls as conventional relaying except for a shorter purification time period and more intense testing. Shellfish from prohibited areas are still relaid for a minimum of 14 days.

SOURCE: FDA, DRAFT.

TABLE C-4

NSSP CONTROLLED PURIFICATION (DEPURATION PLANT) REQUIREMENTS

- Shellfish from restricted or prohibited areas are not transported for purification without written permission from SSCA.
- The depuration system and operations have been demonstrated prior to certification.
- SSCA provides or approves written operating procedures for all critical components from harvesting to distribution as a certified product.
- Depuration plant is licensed, permitted and/or certified to operate by SSCA, who also has administrative control.
- SSCA provides supervision, enforces operating procedures, inspects, evaluates and processes records.
- Shellfish come from estuaries having a restricted areas classification.
- Source seawater is of no less quality than a restricted area and there are no industrial wastes to degrade the shellfish quality.
- Maximum coliform level of tank water is 1 total coliform per 100 ml.
- Adequate laboratory control and monitoring is maintained during the purification operation.
- Final product criteria for soft shelled clams (Mya arenaria) is a median of 50 fecal coliform per 100 grams or less and not more than 10% of the samples exceed 170 fecal coliform per 100 grams. Final product criteria for other shellfish species are specified in operating procedures.
- SSCA performs monthly sanitation inspections, reviews of operating procedures, and evaluations of monitoring and end product quality data during periods of operation. Comprehensive plant evaluation performed annually prior to recertification.
- Depuration operator maintains adequate records consistent with requirements of the operating procedures.
- SSCA maintains records for each facility including sanitary survey reports, analysis of process data, facility sanitary inspection reports, compliance reports.
- SSCA approves all construction/remodeling plans prior to commencing construction or remodeling.
- SSCA forwards to FDA Shellfish Certification Form for listing the plant on the Interstate Certified Shellfish Shippers List.

SOURCE: FDA, DRAFT.

ECONOMIC ANALYSIS

Presently there is little information with which to compare depuration costs with those for relaying in the United States. Direct comparisons of cost evaluations currently available generally are not reliable because they are based on different factors. These cost factors such as location, current prices, harvest yields, harvest methods, losses during processing and processing time are highly variable and are critical to the determination of actual costs. Varying local political and environmental conditions also play a large role in determining the economics of purification. The following information gives a general indication of the relative costs involved in a shellfish cleansing program based on data obtained from people involved in the oyster industry and from local officials.

One of the major economic and planning considerations for a depuration facility is determining the location. The site chosen governs the design and layout of the structure which in turn governs internal operations and product flow (Furfari, 1976). The scale of the plant will mainly be dependent on the availability of polluted shellstock. The annual average productivity of the area indicates the plant capacity that particular site location can support.

Ideally, once the desired plant capacity is determined, the type of treatment, UV or ozone, can be decided upon. Ultraviolet irradiation has traditionally been the treatment of choice in the United States. However, ozone is proven outside the U.S. and is a viable alternative. One reason why UV has been chosen over ozone is due to cost. The costs of setting up an ozone facility are more expensive than UV (Williams et al., 1980; Lozes, 1984). UV treatment is generally used for smaller purification plants and ozone is used for larger facilities due to the higher initial costs. Estimated equipment costs for an ultraviolet facility with a capacity of 100 sacs (sac = 1 1/3 bushel) per day are $10,000 to $12,000. Equipment costs for an ozone facility of the same size are estimated to be $35,000 to $40,000 (Lozes, 1984).

Operating and design costs for a significantly larger facility (capacity of 400 sacs per day) are estimated to range from $250,000 to $350,000, excluding land acquisition costs. The major component of these costs is construction of the plant. Construction costs can be reduced depending on site location (Lozes, 1984). The use of existing structures may also be considered as a means to avoid high construction costs. Many of the northern facilities are converted lobster pools, wet storage areas, garages or shucking houses. Other means of reducing overall costs include having an adequate supply of clean water for use in the cleansing process in order to avoid pretreatment costs. Another cost factor which may be reduced is the expense of laboratory testing. If the state does not perform required laboratory tests, these tests can be performed at the depuration facility at an approximate cost of $20.00 per sample, or $75.00 to $100.00 per batch of shellfish.

Depuration will increase the expense of oyster processing by an estimated 12 to 14 percent (Lozes, 1984). However, certain commercial buyers (particularly restaurants) are willing to pay the increased price to ensure receipt of a high quality depurated product. As the shellfish industry and general public become more cognizant of the value of the purification process, the more this treatment technology will be put into practice.

The alternative purification process, relaying, is commonly reported to be more expensive than depuration. The expected mortality of the shellfish is a prime factor when comparing depuration to relaying. The average mortality rate at a depuration facility is reportedly two to three percent compared to a 20 to 40 percent loss in the relaying process. The higher mortality associated with relaying is due to double handling, predation and disease of shellstock. The higher the mortality rate, the higher the cost per bushel because equipment and labor costs, already committed, remain the same.

The economies of scale are greater for a depuration facility than for a traditional relaying program (Furfari, unpublished). Although the initial costs of a depuration facility are considerably higher than those for relaying, the added cost per depurated barrel (barrel=4 bushels) decreases with higher production rates while the added cost for relaying remains about the same. For example, the 1979 estimated added cost per depurated bushel was $2.00 for a 100 bushel/day plant and $1.00 for a 200 bushel/day plant. However, the estimated (1979) added cost per relaid bushel was about $3.10 for 100 bushels relaid and approximately $3.00 for 200 bushels relaid. The 1979 market price was $7.50 per bushel. Note that the relay estimates are based on a relaying loss of 20 percent (Furfari, unpublished). Relaying using baskets can susbtantially reduce the added cost per bushel by decreasing the mortality rate and reducing the processing time.

Costs for relaying and/or depuration will also vary over time. Relaying costs are lower than depuration costs over the short-term (two to three years) due to initial cost expenditures for depuration facilities. Over the long run, depuration can be less costly than relaying. A break-even analysis depicted by Furfari (unpublished - circa 1979) shows a break-even time of 2.75 years for relay versus depuration at a production rate of 200 bushels per day.

Joint State/Private Relaying

In order to give a general indication of the costs involved in a relay program, estimates are given for relaying accomplished by two methods: private interests and joint state and private interests. Since all the data are not available for analyzing each method, direct comparison of cost and income from the options shown is advised with caution.

Cost factors included in the computations that follow are 1984 updates of figures outlined by Etzold in a 1975 estimate of transplanting oysters from polluted to non-polluted Mississippi waters by a state agency for harvest by a private oyster tonger (Williams et al., 1980). The estimates by Etzold were for long-term averages and included engine overhaul, painting, etc. These figures were updated by the consumer price index (CPI) and durable goods price index. The changes in the index from 1975 to July 1984 are as follows:

Year	CPI	Durable Goods
1975	161.2	165.8
July 1984	307.5	261.3
Price Adjustment Factor	1.908	1.576

The 1984 updated estimated costs to transport the oysters are shown in Table C-5A. The 1984 figures indicate that it would cost the state approximately \$2.83 per barrel (total volume) to transplant the oysters. Part of the total volume dredged and transferred was shells; this partially accounts for a 30 percent recovery rate. Therefore, the transplanting cost per barrel is \$9.34 (\$2.83 x 3.3), or \$2.34 per bushel.

The estimated cost to the private harvestor in 1984 is approximately \$7.92 per barrel or \$1.98 per bushel (Table C-5B.). The sum of transplanting and harvesting costs, \$10.75 per barrel, does not include administrative costs to the state, or any charge for labor and management for tonging the transplanted oysters. An average market price of \$12.00 per bushel (\$48.00 per bbl) was chosen out of current quoted values ranging from \$7.00 to \$17.00 per bushel. Based on this \$12.00 per bushel value, returns to labor and management for oyster tongers would be \$10.02 per bushel (\$12.00 - \$1.98 = \$10.02). Note that the \$10.02 value excludes all costs of transplanting the oysters.

Private Relaying

Data presented for the alternate cleansing method, relaying, by private interests is based upon one season's operation by one commercial firm, as reported by Williams et al. (1980). The cost to have oysters dredged from leased water bottoms by a private interest was \$3.00 per barrel (total volume), based on 1978-1979 prices. The oysters, harvested after 15 days, had a recovery rate of 30 percent of the total volume. Long-term recovery rates are expected to be higher than short-term rates due to reproduction of unrecovered oysters. For example, approximately 70 percent of one batch left on the bottom for six months was recovered.

At a short-term recovery rate of 30 percent (total volume), the per barrel cost of transplanting recovered oysters was 3.3 times the cost per barrel, or \$9.90 per barrel (total volume). The cost to harvest the oysters was \$15.00 per barrel. Therefore, the cost to transplant and recover the oysters was \$24.90 per barrel (\$6.23 per bushel). At a market price of \$30.00 per barrel (\$7.50 per bushel) there would be \$1.27

TABLE C-5

JOINT STATE/PRIVATE RELAYING COSTS

A. COST TO STATE FOR TRANSPLANTING OYSTERS

	1975[a] Value	1978 Price Adjustment Factor	1984 Price Adjustment Factor	1978[b] Adjusted Value[c]	1984 Adjusted Value[c]
Vessel	$ 8,000	1.135	1.576	9,080	12,608
Interest	4,400			4,400	4,400
Operation & Maintenance	58,500	1.212	1.908	70,902	111,618
Haul Out, Scrape, Paint	1,500	1.212	1.908	1,818	2,862
Engine Overhaul	400	1.212	1.908	485	763
Miscellaneous	2,000	1.212	1.908	2,424	3,816
TOTAL ESTIMATED ANNUAL COSTS				89,109	136,067

1978 COST PER BARREL $89,100/48,000 bbl = $1.86
1984 COST PER BARREL $136,067/48,000 bbl = $2.83

B. COST TO OYSTER TONGERS TO HARVEST TRANSPLANTED OYSTERS

	1975[a] Value	1978 Price Adjustment Factor	1984 Price Adjustment Factor	1978[b] Adjusted Value[c]	1984 Adjusted Value[c]
Boat	40	1.135	1.576	45	63
Motor	450	1.135	1.576	510	709
Equipment	100	1.212	1.908	121	191
Fuel, etc.	1,500	1.212	1.908	1,818	2,862
TOTAL ESTIMATED ANNUAL COSTS				$ 2,494	$3,825

1978 $2,500 x 100 Tongers = $250,000
1984 $3,800 x 100 Tongers = $380,000

1978 COST PER BARREL = $250,000/48,000 bbl = $5.20
1984 COST PER BARREL = $380,000/48,000 bbl = $7.92

TOTAL COST per barrel of transplanted oysters:

	1978	1984
Transplant	1.86	2.83
Harvest	5.20	7.92
TOTAL	$7.06	$10.75

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[a] Estimates by Etzold (1975) in Williams et al., 1980.

[b] Estimates updated from 1975 to 1978 by Williams et al. (1980) are given for means of comparison of private relaying costs presented in the text.

[c] Adjusted values are the sum of the 1975 value times (x) the appropriate Price Adjustment Factor.

per bushel profit to include capital, management, and other costs, excluding any cost for obtaining the lease.

The cost of the lease will vary according to the size of the lease and the state from which it is granted. The expenses the private relayer may incur by leasing bottom lands include a lease application fee, yearly lease payment, survey fee and annual patroling expense.

In summary, the above economic analysis indicates that relaying is more expensive than depuration over the long run. Costs over the short-term, however, are lower for relaying than for depuration due to substantially lower initial costs.

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APPENDIX D

EXAMPLES OF LOCAL ORDINANCES FOR REGULATING MARINA ACTIVITIES

APPENDIX D.1

DADE COUNTY, FLORIDA

PROPOSED BOAT DOCKING FACILITY ORDINANCE

(under revision as of 4-85)

EXECUTIVE SUMMARY - OPERATING PERMIT PROGRAM FOR RECREATIONAL AND COMMERCIAL BOAT DOCKING FACILITIES; REQUIREMENTS; WORK EXEMPT FROM CLASS I PERMITS

This ordinance provides an April 1,1984 effective date for an operating permit program for commercial boat docking facilities and recreational boat docking facilities containing or capable of containing ten or more vessels. Operating requirements for recreational facilities include sewage pumpout stations by October 1, 1984 and direct sewage pumpout connections for houseboat liveaboards by January 1, 1985. A technical advisory committee will be appointed by the County Manager to evaluate the methods of providing direct sewage pumpout connections for cruising liveaboards and make recommendations in six months. Transient vessels are exempted from the direct sewage pumpout connection if they have a U.S. Coast Guard approved Marine Sanitation Device (MSD) on board or if upland sanitary facilties are used. Commercial boat docking facilities are required to have upland sanitary facilities by January 1, 1985.

Additional water pollution abatement requirements for commercial and recreational boat docking facilities include: oil and fuel spill cleanup equipment if the facility has vessel fueling capabilities, control of maintenance and repair activities on the upland, derelict vessel removal, floating debris cleanup within the facilities boundaries, a maintenance program for existing storm water disposal systems, trash and fish carcass dipsosal containers on the uplands, and the reporting of pollution control equipment breakdowns. Property owners providing dockage for one to nine houseboat liveaboard vessels must provide direct sewage pumpout connections.

Boat docking facilities with operating permits will be allowed to conduct certain repair work, minor additions and maintenance dredging without having to obtain a Class I Coastal Construction Permit.

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Agenda Item No.

ORDINANCE NO. ________

ORDINANCE AMENDING SECTIONS 24-3 AND 24-35.1, AND CREATING SECTIONS 24-11.1 AND 24-56.16 OF THE CODE OF METROPOLITAN DADE COUNTY, FLORIDA, REGULATING RECREATIONAL AND COMMERCIAL BOAT DOCKING FACILITIES; PROVIDING DEFINITIONS; PROVIDING FOR OPERATING PERMITS AND OPERATING REQUIREMENTS; REQUIRING TECHNICAL ADVISORY COMMITTEE ON CRUISING LIVEABOARD VESSELS; PROVIDING EXEMPTION FROM CLASS I COASTAL CONSTRUCTION PERMITS; PROVIDING SEVERABILITY, INCLUSION IN THE CODE AND AN EFFECTIVE DATE

BE IT ORDAINED BY THE BOARD OF COUNTY COMMISSIONERS OF DADE COUNTY, FLORIDA:

Section 1. Section 24-3 of the Code of Metropolitan Dade County, Florida, is hereby amended as follows:[1]

Sec. 24-3. Definitions.

* * *

(97) Boat docking facility shall mean a place where vessels may be secured to a fixed or floating structure or to the shoreline.

(98) Boat slip shall mean a berthing space for a vessel between two piers or pilings.

(99) Commercial boat docking facility shall mean a boat docking facility which has boat slips, moorings, davit spaces, or vessel tieup spaces of which more than fifty (50) percent are designated for or contain commercial vessels.

(100) Commercial vessel shall mean any vessel engaged in any activity wherein a consideration is paid by the user either directly or indirectly, to the owner, operator or custodian of the vessel; or any vessel engaged in the taking of saltwater fish or saltwater products for sale either to the consumer, retail dealer or wholesale dealer.

(101) Cruising liveaboard vessel shall mean any liveaboard vessel which is not a houseboat liveaboard vessel.

(102) Davit space shall mean an area along a bulkhead or pier where a vessel may be suspended over the water by a mechanical device.

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[1] Underscored words constitute the amendment proposed. Remaining provisions are now in effect and remain unchanged.

(103) Derelict vessel shall mean any vessel left or stored in a wrecked, sunken, junked, or substantially dismantled condition and which is abandoned upon public waters or which is docked at any private property.

(104) Direct sewage pumpout connection shall mean a semi-permanent connection made to a vessel for the purpose of removing vessel sewage from its holding tank or head on a continuous or automatic intermittent basis.

(105) Elutriate test shall mean a test developed by the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers for estimating the potential significance of contaminants present in sediment to be dredged, as set forth in Implementation Manual for Section 103 of Public Law 92-532, July 1977 (Second printing April 1978), Environmental Effects Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi entitled "Ecological Evaluation of Proposed Discharge of Dredged Material Into Ocean Waters".

(106) Holding tank shall mean a receptacle on a vessel which is used to retain vessel sewage.

(107) Houseboat liveaboard vessel shall mean any liveaboard vessel with a barge-type infrastructure or any liveaboard vessel supported on the water by flotation devices.

(108) Liveaboard vessel shall mean a

(a) vessel used principally as a residence; or

(b) vessel used as a place of business, professional or other commercial enterprise and, if used as a means of transportation, said transportation use is a secondary or subsidiary use; or

(c) vessel used by any club or any other association of whatever nature when serving a purpose other than as a means of transportation. (Commercial fishing vessels are excluded from being classified as liveaboard vessels if the boat docking facility where such vessels tieup provides upland sanitary facilities.)

(109) Maintenance dredging shall mean the restoration of a waterway to its previous depth by removing substrate material.

(110) Mooring shall mean a temporary or permanent piling or floating device anchored in open water for the purpose of securing a vessel.

(111) Recreational boat docking facility shall mean a boat docking facility which has boat slips, moorings, vessel tieup spaces, or davit spaces of which fifty (50) percent or more are designated for or contain recreational vessels.

(112) Recreational vessel shall mean any vessel used by its owner or operator for non-commercial purposes.

(113) Maritime sanitary facilities shall mean toilets and sinks designed for human use.

(114) Sewage pumpout station shall mean a mechanical device which is temporarily connected to a vessel for the purpose of removing vessel sewage from its holding tank or head.

(115) Transient vessel shall mean a vessel which is in Dade County waters for a total of six months or less during any calendar year.

(116) Vessel sewage shall mean human body wastes and the wastes from toilets and other receptacles intended to receive or retain human body wastes.

(117) Vessel tieup space shall mean an area abutting a bulkhead or natural shoreline where a vessel may be secured.

Section 2. Section 24-35.1 of the Code of Metropolitan Dade County, Florida, is hereby amended as follows:

Sec. 24-35.1. Operating permits.

No person shall operate a public water system, public sewerage system, or any of the following pollution sources without a valid operating permit issued by the Director of the Department of Environmental Resources Management:

(a) Interim package sewage treatment plants.

(b) Industrial wastewater facilities.

(c) Facilities that could be a source of water pollution.

(d) Facilities that could be a source of air pollution; provided however, the operation of heating equipment or comfort space heating within individual family dwellings or multiple-family dwellings of not more than four units is exempt from the requirement of obtaining a permit pursuant to this section.

The criterion for issuance of an operating permit pursuant to this section is compliance with Chapter 24, Dade County, Code.

Such operating permits shall not be required for the aforesaid facilities, systems, and plants existing on the effective date of this section until one hundred twenty (120) days from the effective date of this section.

This section shall not be immediately applicable to air pollution sources with valid air pollution control operating permits on the effective date of this section. However, said air pollution sources shall comply with this section by obtaining the operating permit required by this section no later than one hundred eighty (180) days from the effective date of this section.

Notwithstanding anything in this chapter to the contrary, such operating permits shall not be required until April 1, 1984 for commercial boat docking facilities within the tidal waters of Dade County or for recreational boat docking facilities with a total of ten (10) or more boat slips, moorings, davit spaces, and vessel tieup spaces within the tidal waters of Dade County. Furthermore, such operating permits shall not be required with respect to any recreational boat docking facility with a total of nine (9) or less boat slips, moorings, davit spaces and vessel tieup spaces within the tidal waters of Dade County.

* * *

Section 3. Section 24-11.1 of the Code of Metropolitan Dade County, Florida, is hereby enacted as follows:

Sec. 24-11.1. Recreational and commercial boat docking facilities; operating requirements; prohibitions.

(1) Sewage pumpout stations for non-liveaboard vessels in recreational boat docking facilities.

(a) All recreational boat docking facilities containing a total of ten (10) or more non-liveaboard boat slips, moorings, davit spaces, and vessel tieup spaces within the tidal waters of Dade County shall install and maintain at all times in a fully operable condition one or two sewage pumpout stations for the removal of vessel sewage from holding tanks or heads as follows:

1. Total of ten (10) to nineteen (19) non-liveaboard boat slips, moorings, davit spaces, and vessel tieup spaces -- one portable sewage pumpout station or one permanent sewage pumpout station.

2. Total of twenty (20) to twenty-nine (29) non-liveaboard boat slips, moorings, davit spaces, and vessel tieup spaces -- one permanent sewage pumpout station.

3. Total of thirty (30) or more non-liveaboard boat slips, moorings, davit spaces, and vessel tieup spaces -- one permanent sewage pumpout station and one portable sewage pumpout station.

(b) All recreational boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code shall submit on or before July 1, 1984, engineering plans for the required sewage pumpout station(s) for review and approval by the Department of Environmental Resources Management. The engineering plans shall include connection of the sewage pumpout station to an appropriate sanitary sewerage system. If the Department of Environmental Resources Management determines it is not feasible to connect to a sanitary sewerage system, then an underground holding tank or discharge to a septic tank-drainfield system shall be used, subject to the approval of the Department.

(c) All recreational boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code shall install and have operational the required number and type of sewage pumpout stations on or before October 1, 1984. If the operator of the boat docking facility is unable to meet the installation deadline due to delays in delivery of the sewage pumpout station or unusual engineering problems, the operator may apply for an extension of time. Said extension request shall be submitted in writing to the Director, Environmental Resources Management, and shall include the reason for the request and a proposed compliance schedule. Based upon a review of the information submitted by the operator of the boat docking facility, the Director, in his or her discretion, may grant extensions of time for compliance with this section.

(d) All recreational boat docking facilities with sewage pumpout stations within the tidal waters of Dade County shall have available on-site standard vessel pumpout fittings to service all types of vessels that use the facility.

(2) Direct sewage pumpout connections for houseboat liveaboard vessels in recreational boat docking facilities.

(a) All recreational boat docking facilities containing a total of ten (10) or more boat slips, moorings, davit spaces, and vessel tieup spaces within the tidal waters of Dade County and which contain houseboat liveaboard vessels shall install and maintain at all times in a fully operable condition a direct sewage pumpout connection at each houseboat liveaboard boat slip or vessel tieup space for the purpose of removing vessel sewage from the houseboat liveaboard vessel on a continuous or automatic intermittent basis.

(b) All recreational boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code and which contain houseboat liveaboard vessels shall submit on or before July 1, 1984, engineering plans for the required direct sewage pumpout connection system for review and approval by the Department of Environmental Resources Management. The engineering plans shall include connection of the direct sewage pumpout connection system to an appropriate sanitary sewerage system.

(c) All recreational boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code and which contain houseboat liveaboard vessels shall install and have operational a direct sewage pumpout connection at each houseboat liveaboard boat slip or vessel tieup space on or before January 1, 1985. Within thirty (30) days of completion of the installation of the direct sewage pumpout connection system, the operator of the recreational boat docking facility shall ensure that all houseboat liveaboard vessels in the boat docking facility are connected to the direct sewage pumpout connection system and are not discharging any raw or partially treated vessel sewage to the tidal waters of Dade County. If the operator of the boat docking facility is unable to meet the installation deadline due to unusual engineering problems or an unusually long distance to a sanitary sewerage line, the operator may apply for an extension of time. Said extension request shall be submitted in writing to the Director, Environmental Resources Management, and shall include the reason for the request and a proposed compliance schedule. Based upon a review of the information submitted by the operator of the boat docking facility, the Director, in his or her discretion, may grant extensions of time for compliance with this section.

(d) Within the tidal waters of Dade County, operators of boat docking facilities which provide boat slips and vessel tieup spaces in recreational boat docking facilities which are designated for or contain transient vessels shall not be required to provide direct sewage pumpout connections if the transient vessel contains a U.S. Coast Guard approved Marine Sanitation Device or if the operator and all occupants of the vessel use upland sanitary facilities provided by the boat docking facility.

(3) The County Manager shall appoint a technical advisory committee to evaluate the potential methods of providing cruising liveaboard vessels with direct sewage hookups in boat docking facilities. The committee shall be selected within two weeks of the effective date of this ordinance and shall present its findings and recommendations to the Board of County Commissioners as to the most feasible methods of sewage hookups for cruising liveaboard vessels within six (6) months of the effective date of this ordinance.

(4) Upland maritime sanitary facilities for commercial boat docking facilities.

(a) All commercial boat docking facilities within the tidal waters of Dade County shall install and maintain at all times in a fully operable condition maritime sanitary facilities for the use of the captains and the crews of the commercial vessels while said vessels are docked.

(b) Operators of all commercial boat docking facilities within the tidal waters of Dade County shall submit on or before July 1, 1984, engineering plans for the required maritime sanitary facilities for review and approval by the Department of Environmental Resources Management.

(c) Operators of all commercial boat docking facilities within the tidal waters of Dade County shall install and have operational the required maritime sanitary facilities on or before January 1, 1985.

(5) Oil and fuel spill cleanup procedures and equipment for boat docking facilities.

(a) All boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code and which dispense fuel or oil shall comply with the following:

1. Floating oil booms and sorbent materials shall be available at the boat docking facility at all times. The Department of Environmental Resources Management shall determine if the oil and fuel spill cleanup equipment is adequate for the size of the boat docking facility. Employees at the boat docking facility shall be trained in the deployment and usage of the required oil and fuel spill cleanup equipment. This equipment shall be subject to inspection by the Department of Environmental Resources Management.

2. All fuel nozzles shall have automatic shut-off valves.

(b) On or before October 1, 1984, the operators of all boat docking facilities required to have an operating permit pursuant to Section 24-35.1 of this Code and which dispense fuel or oil shall comply with the requirements in Section 24-11.1(5)(a)1. and 2. of this Code.

(c) Operators of all boat docking facilities within the tidal waters of Dade County shall immediately notify the Department of Environmental Resources Management, as well as the U.S. Coast Guard and the Florida Marine Patrol, of all oil or fuel spills at the boat docking facility.

(d) Operators of all boat docking facilities within the tidal waters of Dade County shall take immediate corrective action when any oil or fuel spill occurs. This shall include, but not be limited to, the determination of the source of the spill and its elimination, the deployment of oil and fuel containment booms, and the spreading of sorbent materials for collection of the oil or fuel and other appropriate abatement measures.

(6) Water pollution abatement requirements for boat docking facilities.

(a) Within the tidal waters of Dade County all recreational boat docking facilities containing a total of ten (10) or more boat slips, moorings, davit spaces, and vessel tieup spaces, and all commercial boat docking facilities shall comply with the following water pollution abatement measures:

1. The operators of all boat docking facilities which conduct or allow to be conducted boat maintenance and repair activities shall designate a specific area of the upland property of the boat docking facility for said activities. Said operators shall issue rules and regulations concerning the type of maintenance and repair work which may be conducted within said area and shall ensure that the area is kept free of all liquid and solid wastes that could enter Dade County tidal waters through overland runoff or storm sewer systems. A copy of said rules and regulations shall be submitted as part of the boat docking facility's application for a Dade County operating permit. If the changing of oils and hydraulic fluids from boat engines is to be conducted or allowed, the operator of the boat docking facility shall provide a tank or drum for the deposit of all waste oils and fluids and it shall be located a sufficient

distance from the water, as determined by the Department of Environmental Resources Management, to prevent oil spills.

2. The operators of all boat docking facilities which currently contain derelict vessels shall submit with their Dade County operating permit application a compliance schedule for removal and disposal of the derelict vessels. Said compliance schedule, if acceptable to the Department of Environmental Resources Management, shall become a part of the operating permit for the boat docking facility. The operators of all boat docking facilities shall include in each boat slip, mooring, davit space, or vessel tieup space rental or lease agreement a provision which requires the owner of each vessel to immediately refloat any vessel which sinks in the boat docking facility.

3. The operators of all boat docking facilities shall be responsible for the cleanup and removal of floating debris, both natural and manmade, from the water areas within the boundaries of the boat docking facility.

4. The operators of all boat docking facilities shall provide the Department of Environmental Resources Management with a plan of the existing storm water disposal system, if any such system exists, for their boat docking facilities with their application for a Dade County operating permit. A plan for regularly scheduled maintenance of the storm water disposal system shall also be included with the application. It shall be the boat docking facility operator's responsibility to ensure that catch basins, oil and grease separators and other system components are cleaned on a regular basis and that wastes other than stormwater are not discharged into the stormwater disposal systems.

5. All boat docking facilities shall have an adequate number, as determined by the Department of Environmental Resources Management, of trash disposal containers on the upland portion of the property to serve the needs of the vessel owners that use the boat docking facility.

6. All boat docking facilities which provide fish cleaning tables shall provide covered trash containers at a convenient location adjacent to the cleaning tables for the disposal of fish carcasses. Permanent signs shall be posted at each cleaning table by the operator of the boat docking facility advising the users thereof to dispose of fish carcasses in trash containers.

7. In the event of any breakdown or lack of proper functioning of any equipment required in boat docking facilities by this Code, it shall be the duty of the operator of the boat docking facility to immediately notify the Department of Environmental Resources Management and to take immediate corrective action to restore the equipment to full and proper operation.

(7) Prohibitions for boat docking facilities.

(a) Within the tidal waters of Dade County it shall be unlawful after January 1, 1985, for any person providing boat slips or vessel tieup spaces for one to nine vessels to rent, lease, or otherwise provide a slip or space for any houseboat liveaboard vessel unless said vessel is provided by the operator of the boat docking facility with a direct sewage pumpout connection to an approved land-based sewage treatment system.

(b) It shall be unlawful for any person to build, erect, install or use any device, machine, equipment or other contrivance, the use of which will conceal any discharge which would otherwise constitute a violation of any of the provisions of this chapter.

Section 4. Section 24-58.16 of the Code of Metropolitan Dade County, Florida, is hereby enacted as follows:

Sec. 24-58.16. Class I coastal construction permit exemptions for boat docking facilities with operating permits; procedures.

(1) All recreational and commercial boat docking facilities which have a valid operating permit from the Department of Environmental Resources Management may be authorized by the Department to perform at the permitted facility certain in-water repairs and minor additions, and maintenance dredging work without obtaining a Dade County Class I Coastal Construction permit. The work which may be authorized under an operating permit is as follows:

(a) Repair or replacement of seawalls or bulkheads not exceeding three hundred feet (300') in length at the mean high water line or at the original location of the seawalls or bulkheads.

(b) Construction of dock(s) provided that the proposed dock(s) extends twenty-five feet (25') or less waterward of the existing seawall, bulkhead, or shoreline and, together with associated tie-up facilities, does not protrude into the water more than twenty-five percent (25%) of the width of the waterway, or forty feet (40'), whichever extends the least into the water, and, further, provided no dredging and filling is associated with the project.

(c) Repair or restoration of docks or dock pilings limited to their original dimensions.

(d) Installation or replacement of mooring piles or buoys, when it is determined by the Department of Environmental Resources Management, that the proposed installation will not present a hazard to navigation.

(e) Placement of riprap in front of an existing seawall, bulkhead or shoreline, provided the Department of Environmental Resources Management determines no adverse environmental impact results therefrom.

(f) Construction of new seawalls or bulkheads, not exceeding two hundred feet (200') in length, at the mean high water line.

(g) Davit installation on a new seawall, bulkhead or dock.

(h) Repair or replacement of wave baffles at their original location and dimensions.

(i) Maintenance dredging projects involving the removal from submerged lands of less than ten thousand (10,000) cubic yards of material, when dredged material is to be deposited on a self-contained upland site.

(j) Installation of aids to navigation.

(2) Requests for boat docking facility repairs and minor additions, and maintenance dredging shall be made to the Department of Environmental Resources Management and said request shall include the following information:

(a) A brief description of the proposed work and a tentative timetable for completion of the work.

(b) A plan or sketch of the proposed work.

(c) The name of the contractor who will perform the work.

The Department of Environmental Resources Management may require the submission of the following additional information for work which involves the construction of new structures, repair or replacement of seawalls or bulkheads or maintenance dredging work:

(d) Three (3) or more complete sets of construction plans and calculations for the proposed work, prepared by an engineer registered in the State of Florida, provided, however, that said plans and calculations are subject to review and approval by the Department of Environmental Resources Management. These requirements may be fulfilled by an architect registered in the State of Florida for work described in Section 24-58.16(1)(b), (c), (d), (e), (g), (h), and (j).

(e) Certification by an engineer registered in the State of Florida qualified by education and experience in the area of construction that:

To the best of his knowledge and belief, the proposed work does not violate any statutes, zoning law, ordinance, or promulgated administrative rule which may be applicable to such area or construction work, and that diligence and recognized standard practices of the profession were exercised in the design process with the intent to avoid the following effects.

1. Harmful obstruction or undesirable alteration of the natural flow of the water within the area of the work.

2. Harmful or increased erosion, shoaling of channels or stagnant areas of water.

3. Material injury to adjoining land.

(f) Zoning approval from the appropriate local zoning authority.

(g) Evidence of ownership of the submerged land upon which the proposed work will occur.

The following information shall only be required for maintenance dredging work:

(h) The type of dredging equipment to be used.

(i) The type of water quality control equipment to be used during dredging.

(j) A water quality monitoring program to be conducted by the applicant during the dredging operation.

(k) The method of turbid water runoff control from the spoil piles on the upland portion of the property.

(l) The ultimate disposal site of the dredged material.

(m) The results of an elutriate test performed on the proposed dredge material if work is to be performed in the Miami River.

(3) Upon completion of the work, a set of reproducible record prints of drawings showing those changes made during the construction process, based on the marked-up prints,

drawings and other data furnished by the contractor shall be submitted to the Department of Environmental Resources Management. The drawings shall be prepared by an engineer registered in the State of Florida. These requirements may be fulfilled by an architect registered in the State of Florida for work described in Section 24-58.16(1)(b), (c), (d), (e), (g), (h), and (j).

Section 5. If any section, subsection, sentence, clause or provision of this ordinance is held invalid, the remainder of this ordinance shall not be affected by such invalidity.

Section 6. It is the intention of this Board of County Commissioners, and it is hereby ordained that the provisions of this ordinance shall become and be made a part of the Code of Metropolitan Dade County, Florida. The sections of this ordinance may be renumbered or relettered to accomplish such intention, and the word "ordinance" may be changed to "section", "article", or other appropriate word.

Section 7. This ordinance shall become effective ten days after the date of its enactment.

PASSED AND ADOPTED:

Approved by County Attorney as
to form and legal sufficiency.

Prepared by: PST

APPENDIX D.2

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

AGREEMENT

THIS AGREEMENT, made and entered into this ______ day of ______________________, 1979, by and between the CITY OF BERKELEY, a municipal corporation, hereinafter called City, and ____ hereinafter called Berther.

WITNESSETH:

WHEREAS, City operates a Marina, and

WHEREAS, City has authorized live-aboard status to a specific number of cruising type vessels berthed in the Berkeley Marina, and

WHEREAS, the San Francisco Bay Conservation and Development Commission has issued a permit authorizing a selected number of live-aboard berths at the Berkeley Marina, and

WHEREAS, the live-aboard status is granted in an attempt to increase the security and surveillance for the Berkeley Marina, and

WHEREAS, Berther is willing and prepared to offer security and surveillance to the City as a condition of being granted live-aboard status at the Berkeley Marina.

NOW, THEREFORE, for and in consideration of the mutual promises and conditions herein contained, City and Berther agree as follows:

1. TERM:

This Agreement shall be in effect for the duration of the Bay Conservation and Development Commission Permit No. 5-79, Amendment No. I, attached hereto as Exhibit A, and by this reference made a part of this Agreement, unless terminated by either party under conditions herein contained.

2. CONDITIONS:

Berther agrees to abide by the conditions stated in Permit No. 5-79, Amendment No. I, and City of Berkeley Ordinance 5032-N.S. attached hereto as Exhibit B, and by this reference made a part of this Agreement and any amendments thereof. Violation of any condition may result in the termination of the live-aboard status for the berther.

3. TERMINATION:

Berther may terminate his/her live-aboard status by written notification of such to the Berkeley Marina Administration Office.

City may terminate Agreement for cause, non-compliance with the conditions of this Agreement or by giving thirty (30) days written notice to the Berther.

4. SECURITY AND SURVEILLANCE:

Berther shall use reasonable efforts to provide security and surveillance assistance to Marina staff. Berther shall report to the Marina Office any violation of Exhibit A and/or Exhibit B and any unlawful activities that occur within the Marina to which he/she is a witness.

5. RESIDENCY:

As a condition of obtaining and retaining live-aboard status at the Berkeley Marina, Berther must reside aboard his/her vessel for a minimum of nine months of any calendar year.

Live-aboard status may be retained while vessel is absent from the Marina for a period up to and including one year. Absence beyond one year will result in termination of current live-aboard status and the placement of Berther onto the waiting list for selection for future live-aboard status.

6. SIGNATURES:

All adults residing aboard Berther's vessel shall sign this contract, or provide the Marina Administration Office with a letter agreeing to abide by this Agreement, prior to living aboard.

7. NUMBER OF AUTHORIZED LIVE-ABOARD BERTHS:

The maximum number of live-aboard berths in the Berkeley Marina as of July 1, 1980, shall be forty (40). If more than forty (40) berthers have live-aboard status as of that date, this Agreement may be terminated effective July 1, 1980.

8. HOLDING TANKS:

Berther, as a condition of his/her live-aboard status, shall install, use, and maintain in operating order holding tank(s) with sufficient capacity to meet the minimum tank size(s) as identified in Exhibit C, attached hereto and by this reference made a part of this Agreement.

City shall maintain in operating order at all times a free pumpout facility for use by Berther and other vessels berthed at the Marina.

9. THROUGH-HULL FITTINGS:

All through-hull fittings for sewage and greywater discharge on Berther's cruising type vessel will be sealed by Marina Office prior to Berther obtaining permission to live aboard. Opened fittings must be resealed by Marina Office within one day of return to the Berkeley Marina.

10. INDEMNITY:

Berther shall indemnify, hold harmless, and defend City from and against any and all claims arising from any actions or omissions of Berther, his/her agents, employees, servants or licensees, or arising from any accident, injury or damage whatsoever caused to any person or property occurring in, on or about the use of City's property that arises from this Agreement and from and against all costs, expenses and liabilities incurred in or in connection with any said claim or any proceeding brought thereon.

11. MISCELLANEOUS:

a. Berther shall not assign, subcontract or transfer its live-aboard status to another party.

b. In the rendering of the services herein provided for, Berther is and shall be considered for all purposes an independent contractor and not an employee of the City or any of its departments.

c. Violation of any of the terms of this Agreement may result in the termination of the live-aboard status for Berther and the termination of this Agreement.

IN WITNESS WHEREOF, City and Berther have hereunto set their names, the day and year first above written.

CITY OF BERKELEY

By________________________________

CITY MANAGER

Approved as to form:

____

Associate Attorney

BERTHER

____

EXHIBIT A

STATE OF CALIFORNIA
EDMUND G. BROWN JR., Governor

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION
30 VAN NESS AVENUE
SAN FRANCISCO, CALIFORNIA 94102
PHONE: 557-3686

PERMIT NO. 5-79
(Issued on June 4, 1979, As
Amended Through November 27, 1979)
AMENDMENT NO. 1

City of Berkeley
2180 Milvia Street
Berkeley, California 94704

ATTENTION: Forrest Craven
Acting City Manager

Gentlemen:

On May 17, 1979, the San Francisco Bay Conservation and Development Commission, by a vote of 21 affirmative and 0 negative, approved the resolution pursuant to which this permit ~~is~~ had been issued. Moreover, on November 8, 1979, pursuant to Commission Regulation Section 10722, the Executive Director approved the amendment request to which this amended permit is hereby issued:

I. Authorization

A. Subject to the conditions stated below, the permittee is granted permission to moor and use no more than ~~40~~ 52 live-aboard, cruising type vessels at no more than ~~40~~ 52 existing berths to provide increased security and surveillance assistance at the Berkeley Marina, in the City of Berkeley, Alameda County. The number of live-aboard boats and berths authorized shall be reduced and permanently maintained at no more than 40 by July 1, 1980.

B. This authority is generally pursuant to and limited by the application filed April 6, 1979, and your letter and amendment request dated October 1, 1979, including its accompanying exhibits, but subject to the modifications required by conditions hereto.

C. The live-aboard program authorized herein must commence prior to October 1, 1979, or this permit, as amended, will lapse and become null and void. This permit, as amended, will terminate on September 1, 1982, unless a written extension of time is granted pursuant to Special Condition II-H of the permit, as amended.

D. The project will result in a permanent change of use for no more than 40 boat berths, currently used for cruising type recreational vessels, to allow berthing for no more than 40 live-aboard, cruising type vessels. No new public access will be provided.

II. Special Conditions

The authorization, as amended, made herein shall be subject to the following Special Conditions in addition to the Standard Conditions in Part IV:

A. Holding Tank Standards. The permittee shall not grant or continue live-aboard status for any vessel until a standard for holding tank capacity based on the number of vessel occupants, use of a standard marine or recycle toilet, and the presence or absence of other waste generating fixtures (such as showers), has been established and approved by or on behalf of the Commission. The standard shall assure that no less than three (3) days estimated volume of waste can be contained in the holding tank.

B. Installation of Holding Tanks and Sealing of Through-Hull Fittings. The permittee shall not grant or continue live-aboard status to any vessel until: (1) a holding tank that meets the approved holding tank capacity standard pursuant to Special Condition II-A has been installed and is fully operational aboard the vessel; (2) the plumbing system aboard the vessel has been modified to collect and transmit greywater as well as sewage to the holding tank; (3) all through-hull fittings for sewage and greywater discharge have been sealed in such a manner that any disconnection of the fitting will be apparent; and (4) the permittee has inspected the vessel's holding tank and plumbing system and certified that the system complies with the above condition and does not leak.

C. Report to the Commission. Each year, starting January 15, 1980, for a period of twelve (12) years, the permittee shall report to the Commission on the effect of the live-aboard program on the water quality and security of the marina basin. The report shall include the following information: (1) a comparison of the incidence of vandalism before and after institution of the live-aboard program; (2) a comparison of water quality measurements, specifically including coliform count, within the marina basin to the same water quality measurements in neighboring areas outside the marina basin; (3) a comparison of water quality measurements provided pursuant to Special Condition II-C-2 with measurements taken in preceding years; (4) an assessment of any significant changes in the composition, diversity, or density of benthic populations in the marina basin; (5) the number of trips made by live-aboard vessels outside the marina basin over a twelve-month period; and (6) a brief summary of the information contained in the logs required by

Special Condition II-D-5 on the number of visits per vessel per month to the pump-out stations. This section of the report should also relate the size of the vessel, the size of the vessel's holding tank, and the number of occupants living aboard the vessel to the number of trips made by the vessel to the pump-out station.

D. Use of Marine Toilets

1. The permittee shall not grant or continue live-aboard status to any vessel until the permittee has made it a requirement of live-aboard status that any live-aboard berthed, if equipped with a marine toilet (head), shall contain an adequate U. S. Coast Guard Type III holding tank, that would receive and retain sewage from the boat's head as well as any greywater from any sinks, shower or other devices, and would preclude discharge of sewage, chemicals or greywater into the waters of the marina.

2. The permittee shall not grant or continue live-aboard status to any vessel until the permittee has made it a requirement of live-aboard status that any dumping of solid or liquid waste or greywater into that portion of San Francisco Bay within the mooring area is forbidden and any such dumping shall be cause for immediate cancellation of the right of such use or occupancy and shall be reported to all appropriate authorities.

3. The permittee shall not grant or continue live-aboard status to any vessel until the permittee has submitted to the Commission a copy of the berthing agreement which includes the requirements of Special Conditions II-D-1 and II-D-2. The permittee shall also provide the Commission with a list of the names of all boats, owners, and occupiers of boats granted live-aboard status. This list shall be updated at least every calendar year.

4. The permittee shall not grant or continue live-aboard status to any vessel until the permittee has provided, in the marina, adequate restrooms for boat owners and users, and guests.

5. The permittee shall permanently and adequately enforce, through appropriate policing, the rules and requirements adopted pursuant to this condition. Upon execution of this authorization, the permittee shall submit to the Commission's staff the name, address and telephone number of the person who is responsible at the marina for enforcing the rules and regulations adopted pursuant to this condition. The permittee shall not grant or continue live-aboard status to any vessel until the permittee

has established a log at each pump-out station and required that the operator or owner of each vessel having live-aboard status record the day and time that the holding tank was pumped out. The permittee shall certify that the logs are accurate and shall maintain the logs for public inspection for at least two years from the date the log is first established.

6. The Commission specifically reserves the right, in the event of repeated or serious problems with dumping of sewage or grey-water from boats into the Bay within the marina, to require in addition to the above either that shoreside sewer connections be provided for each offending boat berth and that said boat be connected to said sewer whenever moored in the marina or, in the alternative, that the permittee, upon written demand of or on behalf of the Commission, shall permanently remove or cause to have removed said offending boat or boats from the marina.

E. Water Quality Measurements. After commencement of the live-aboard program, but in no case later than September 1, 1979, the Berkeley Public Health Department shall collect and analyze water samples from at least ten (10) sample locations within the marina basin (at least six (6) of the sample locations shall be adjacent to approved live-aboard vessels), and from at least four (4) sample locations near the entrance of the marina. The samples shall be analyzed for coliform, and shall be collected on a weekly basis for the first three (3) months of the live-aboard program. Thereafter, samples shall be collected and analyzed once a month. These measurements shall provide the information used in the permittee's report to the Commission as required pursuant to Special Condition II-C.

F. Pump-Out Station. No later than July 1, 1980, an additional pump-out station, available free of charge to all vessels, shall be installed and fully operational at the fuel dock adjacent to the marina entrance. Thereafter, both pump-out stations shall be kep functional and in good repair and made available for use by any vessel at all convenient times of all days and evenings.

G. Sanitation. The permittee shall immediately require that no person shall throw, discharge, deposit or place refuse, sewage, or waste matter of any description into the waters of the marina basin, nor shall any person discharge or deposit material of any kind on the banks, docks, or walks in any location where the same may be washed, or accidentally deposited into the waters of the marina basin.

H. Program Duration. The live-aboard uses authorized herein are limited to a three (3) year period commencing June 1, 1979. Extensions of time for continuing the live-aboard program may be approved by the Commission for additional three (3) year periods thereafter. Such extensions shall be granted or denied on the basis of consistency with any policies adopted by the Commission as a result of the Commission's marina study and compliance with all terms and conditions of this authorization.

I. Log Maintained by Live-Aboard Vessels. No later than September 1, 1979, the permittee shall require that each live-aboard vessel in the marina shall maintain a log of the number and duration of trips made by the live-aboard vessel outside the marina basin. The logs shall be made available to the permittee for use in preparing the permittee's annual report to the Commission, and also be provided by the permittee to any public agency requesting the logs.

III. Findings and Declarations

This authorization, as amended, is given on the basis of the Commission's findings and declarations that the work authorized is consistent with the McAteer-Petris Act, the San Francisco Bay Plan, and the California Environmental Quality Act for the following reasons:

A. Use. Bay Plan Map No. 4 indicates that there is an existing marina at the site. Inasmuch as the live-aboard vessels will provide increased security and surveillance for the entire marina, thereby enhancing the marina's primary function of providing safe moorage for recreational vessels; and since the live-aboard vessels will be equipped with approved holding tanks to prohibit dumping of any sewage or greywater in the basin, the granting of live-aboard status to no more than 40 vessels is consistent with the Bay Plan Policies on Marinas.

B. Fill. The live-aboard vessels, a form of fill under the BCDC law, moored pursuant to this authorization, as amended, will conform to the Bay Plan Policies concerning Houseboats (pages 28 thru 29) because they will be moored at berthing locations where increased sedimentation in the harbor will not result over that which would result in any case due to the mooring of other types of craft. Secondly, in accordance with the conditions listed under Section II of this authorization, as amended, no sewage, greywater, liquid or solid waste will be discharged into the waters of the marina from the live-aboard vessels which will be equipped with on-board facilities acceptable to both the Regional Water Quality Control Board and the U. S. Coast Guard. Thirdly, no new fill for support facilities for the proposed live-aboards is necessary or authorized. Lastly, the permittee, the concerned local government, has approved permanent live-aboard status for no more than 40 vessels as a means of providing increased security and surveillance.

C. Precedence. The Commission notes that this is the first application for granting live-aboard status to a large number of vessels in a primarily recreational marina. The Commission notes that the permittee has advised the Commission that the reason for granting live-aboard status to so many vessels is to provide increased security and surveillance assistance to the marina, thereby enhancing its value as a recreational marina. The Commission advises the permittee that this application is being approved as an experiment and will not be used as a precedent for other similar proposals.

D. Environmental Impact. The City of Berkeley, the lead agency and the permittee, issued and adopted a Negative Declaration for this project on July 19, 1978. The Negative Declaration states that vessels will be equipped with approved holding tanks to prohibit the dumping of any sewage or greywater into the marina basin and that the vessel owners must comply with the sewage control requirements of the permittee.

E. Water Quality. The conditions listed under Section II of this authorization, as amended, which control the treatment of wastes, refuse, and greywater from live-aboard vessels and limit the number of such vessels will assure that the waste treatment capacity of the on-site facilities are not exceeded; thus, these conditions assure that the policies of the Bay Plan on water pollution which states that projects built on the Bay should have their liquid and solid wastes treated on the premises or in a public treatment plant will be satisfied. In addition, the determination of the permittee's Public Health Department that high water quality standards in the marina basin and adjacent Bay waters are being maintained as long as live-aboards are permitted to moor at the marina shall assure that the standards of the Federal Water Pollution Control Act will also be met.

F. Public Trust. By this authorization, as amended, the Commission finds that the mooring of the vessels authorized herein is consistent with the public trust.

G. Conclusion. For all the above reasons, the public benefits exceed any public detriment from the project. The Commission further finds, declares, and certifies that the activities authorized herein are consistent with the Commission's Amended Management Program for San Francisco Bay as approved by the Department of Commerce under the Federal Coastal Zone.

IV. Standard Conditions

A. All required permissions from governmental bodies must be obtained before the commencement of work; this includes, but is not limited to, the U. S. Army Corps of Engineers, the State Lands Commission, the Regional Water Quality Control Board, and the oity and/or county in which the work is to be performed, whenever any of these may be required. This permit, as amended, does not relieve the permittee of any obligations imposed by State or Federal law, either statutory or otherwise.

B. The attached Notice of Completion shall be returned to the Commission within thirty (30) days following completion of the work.

C. Work must be performed in the precise manner and at the precise locations indicated in your application.

D. Work must be performed in a manner so as to minimize muddying of waters, and if diking is involved, dikes shall be waterproof. If any seepage returns to the Bay, the permittee will be subject to the regulations of the Regional Water Quality Control Board in that region.

~~E. The rights derived from this permit are assignable, but such assignment shall not be effective until the assignee shall have executed and the Commission shall have received an acknowledgment that the assignee has read and understood the application for this permit and the permit itself, and agrees to be bound by the conditions hereof.~~

~~F.~~ E. Except as otherwise noted, violation of any of the terms of this permit, as amended, shall be grounds for revocation. The Commission may revoke any permit for such violation after a public hearing held on reasonable notice to the permittee. ~~or to his assignee if the permit has been effectively assigned.~~

~~G.~~ F. This permit, as amended, shall not take effect unless the permittee executes the original of this permit, as amended, and returns it to the Commission within fifteen (15) days after the date hereof.

Executed at San Francisco, California, on behalf of the San Francisco Bay Conservation and Development Commission on the date first above written.

Michael B. Wilmar
MICHAEL B. WILMAR
Executive Director

MBW/RJB/st

cc: U. S. Army Corps of Engineers, Attn: Regulatory Functions Branch
San Francisco Bay Regional Water Quality Control Board,
Attn: Certification Section
Environmental Protection Agency, Attn: Eric Yunker, E-4-2
Chuck Roberts, Berkeley Park and Recreation

* * * * * * * *

Receipt acknowledged, contents understood and agreed to:

Executed at Berkeley, California

City of Berkeley

On December 4, 1979

by:

Acting City Manager
Title

EXHIBIT B

ORDINANCE NO. 5032 -N.S.

ESTABLISHING RULES AND REGULATIONS FOR THE OPERATION OF THE BERKELEY MARINA, AND REPEALING ORDINANCE NO. 4159-N.S. AND ALL ORDINANCES AMENDATORY THEREOF.

BE IT ORDAINED by the Council of the City of Berkeley as follows:

Section 1. DEFINITIONS.

Whenever any of the words hereinafter defined are used in this ordinance, they shall be construed to mean the following:

a. "Berkeley Marina", hereinafter referred to as "Marina", shall mean the area owned or controlled by the City of Berkeley on or within the breakwater and the sea walls and the extensions thereof located on the Berkeley waterfront approximately between Allston Way and Virginia Street, and West Marina Drive.

b. "Marina Supervisor" shall mean the Marina Supervisor of the City of Berkeley or his/her duly authorized representative.

c. "Director of Finance" shall mean the Chief Financial Officer of the City of Berkeley, or his/her duly authorized representative.

d. "Vessel" shall include every descripton of watercraft used, or capable of being used, as a means of transportation on the water.

(1) "Non-Cruising Type Vessel" shall include any vessel that was not specifically designed for operating in open waters. This type of vessel includes any non-self-propelled vessel such as barges and/or any non-cruising type houseboats.

(2) "Cruising Type Vessel" shall include any sailboat, motor driven craft or cruising type houseboat that was specifically designed for operating in open waters.

e. "Residence" shall mean any vessel, located within the Marina boundaries, used for overnight accommodation between the hours of 2:00 a.m. and 6:00 a.m. for more than three (3) nights in a seven (7) day period.

Section 2. MARINA SUPERVISOR AUTHORITY.

The Marina Supervisor, acting under the orders and jurisdiction of the Parks and Marina Superintendent, the Director of Recreation, Parks and Community Services, and subject to the authority of the City Manager and City Council, shall have full authority in the interpretation and enforcement of all regulations affecting the Marina, and all orders and instructions given by him/her in the performance of his/her duties shall be obeyed.

Every vessel entering the Marina shall immediately become subject to the order and direction of the Marina Supervisor, and he/she shall have the authority to enter upon any vessel in the Marina in the performance of his/her duties.

The Marina Supervisor shall have the authority to designate the area in which any vessel shall be berthed and may require any vessel to change its berth in the Marina. If a vessel does not change berths after notification, it may be moved by the Marina Supervisor and towing charges added. Vessels may anchor in the Marina only with the permission of the Marina Supervisor.

The Marina Supervisor, or his/her authorized representative may have the right of refusal for Marina use to any vessel at his/her discretion, i.e., derelict boats, vessels needing major overhaul and non-self-propelled vessels other than sailboats.

Section 3. APPLICATION FOR BERTHS.

Application for berths in the Marina shall be made upon forms furnished by the Marina Supervisor and shall be granted in the order of the request. Preference will be given to the vessel most suitable to the berth to be rented.

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Section 4. CANCELLATION OF BERTHS.

The Marina Supervisor shall be notified in writing of the exact date of release of assigned facilities; charges will continue until such notice is given. Written notice can be made by the return of the vessel owner's copy of the original application for the berth with the request for release written in the space provided thereon. Required time of notice is at least thirty (30) days as established by resolution of the Council of the City of Berkeley. Telephone cancellation will be accepted, provided written confirmation is received within five (5) days.

The Marina Supervisor shall have the authority to cancel assigned berth(s) with thirty (30) days notice in writing to the boat owner at the address of record for any violation of this ordinance, or continued late payment of charges.

Section 5. TRANSFER OR SUBLEASING OF A BERTH.

Transferring a berth to a new occupant, or subleasing, is not permitted. However, when a berth holder sells his/her boat and cancels the berth, and the purchaser wishes to retain the berth, it may then be transferred to the new owner. The new owner must complete a berth application with berth deposit equivalent to one (1) month's rent within seven (7) days from the date that notice of cancellation was given.

The berth holder may allow another boat owner to use his/her berth for a period not to exceed thirty (30) days. Notice must be given in advance to the Marina office and a Temporary Use of Berth Form must be completed prior to the effective date of change.

Section 6. MAINTENANCE AND CARE IN BERTHING VESSELS.

All vessels shall be berthed with proper care and equipment, and such berthing equipment shall be maintained at all times in such condition as to meet with the approval of the Marina Supervisor. In the event that vessels are not so maintained, the Marina Supervisor may supply lines and fittings, or replace inadequate lines and fitting, or may care for the vessel in such a manner as to prevent damage. A charge for this service, and for any lines, fittings or materials supplied will be made, and payment shall be made at the end of each month. Any lines, fittings and materials used and supplied by the Marina Supervisor to protect vessels are not returnable.

No person shall berth within the Marina any vessel of any kind whatsoever which is so unseaworthy, or in such a badly deteriorated condition that it is liable to sink or damage docks, floats or other vessels, or which may become a menace to navigation, except in cases of extreme emergency, in which case the owner will be liable for any damage caused by such vessel.

In the event a vessel is wrecked or sunk within the Marina, it shall be the owner's responsibility to mark its position and provide for the raising and disposition of such vessel and assume all liability for damage to City property or other vessels in the Marina.

Section 7. REGISTRATION AND NUMBERING; FURNISHING INFORMATION TO MARINA SUPERVISOR.

Every vessel entering the Marina must be registered and numbered as provided by the laws of the State of California or the U.S. Government regulations regarding documented vessels.

The owners of vessels entering the Marina shall furnish all documents relating to the vessel and the ownership thereof before the berthing application can be accepted. The application must be in the registered owner's name.

Section 8. ACCIDENT REPORTS.

All boating accidents involving damage or injury to any private or public property require the operator of the vessel which caused the accident to complete an accident report provided by the Marina Supervisor within twenty-four (24) hours of the incident.

Section 9. ACCESS TO MARINA AND VESSELS.

The berthing area of the Marina is closed to the general publice, except to owners of vessels berthed in the Marina, their authorized guests and those receiving special permission from the Marina Supervisor. "K" Dock is open and accessible to the general public during daylight hours.

Section 10. BERTH RATES AND SERVICE CHARGES.

The rates for service, supplies and rent at the Marina shall be established by resolution of the Council of the City of Berkeley.

All charges for rent shall be due and payable monthly in advance on or before the first day of each month and shall be delinquent on the 15th day of the month for which the payments are due. All charges for service and supplies shall be due upon billing and shall be delinquent fifteen (15) days thereafter. If any payment is delinquent as provided herein, a penalty of ten percent (10%) shall be added and paid in addition thereto.

Boat owners who wish to remove their vessels from the Marina for a period in excess of thirty (30) days and do not want to release their berths permantly may pay one-half (1/2) the monthly berth rates. The Marina will use the berth(s) for temporary and visitor berthing. Fifteen (15) days notice is required in writing to the Marina office prior to placing berth on one-half (1/2) rate, and fifteen (15) days notice in writing is required prior to returning the vessel to the berth.

Use of a berth is restricted to one (1) vessel only, not including a dinghy or small boat up to twelve (12) feet in length, provided that neither vessel extends beyond the limits of the berth width and length. An exception to this provision may be permitted by the Marina Supervisor if the size of the berth will permit its use by two (2) or more vessels. The rental charge for those berths will be based on the overall length of each vessel, or the length of the berth, whichever is greater.

Section 11. NON-PAYMENT OF CHARGES.

a. No person shall remove or cause to be removed from the Marina any vessel upon which charges for berth rental, dry storage, or any other proper charges are delinquent, without paying all such delinquent charges.

b. It shall be unlawful for any person to violate the provisions of subdivision a. of this section, or to willfully give false information to the Marina Supervisor or the Director of Finance in order to secure the removal of a vessel.

c. When any charges have been thirty (30) days delinquent, the Marina office will be advised by the City of Berkeley's Department of Finance to secure the vessel. The Marina office will post a notice of delinquent payment and secure the vessel to prevent removal. A labor charge of one (1) hour will be added to the account for securing of the vessel.

d. When the charges for berth rentals, dry storage, or any other proper charge on any vessel are delinquent, the Director of Finance is empowered to enforce the City's lien pursuant to the procedures set forth in Article 4, Sections 500 through 505 of the California Harbors and Navigation Code.

Section 12. GEAR LOCKERS.

Gear lockers are available only to vessel owners having vessels berthed in the Marina and at rates established by the City Council. Lockers must be vacated upon the release of berth. Rental of lockers may be restricted to a maximum of two (2) lockers assigned to a berth holder. Individual gear lockers shall be kept in a safe condition with a minimal amount of flammable material and shall be subject to inspection by the Marina Supervisor at all reasonable times.

Section 13. DISPOSING OF REFUSE.

a. No person shall throw, discharge or deposit from any vessel or from the shore or wharf, or otherwise, any refuse matter of any kind whatsoever into or upon the waters or land area of the Marina.

b. No person shall dump or discharge oil, spirits, inflammable liquid or contaminated bilge water into the Marina. This also includes excessive unburned fuels discharged from engine exhausts.

c. All garbage must be deposited in receptacles furnished by the City of Berkeley for that purpose.

d. All fish must be disposed of within eight (8) hours from the time of catching. No person shall throw fish or bait overboard at the dock or from a vessel. Fish cleaning is not permitted on vessels, floats or any other area of the Marina, except at designated fish cleaning areas.

Section 14. HAZARDOUS CONSTRUCTION PROHIBITED.

Floats, gangways, tops of lockers and docks shall be kept clear at all times of skiffs, tenders, miscellaneous gear, debris, or hazardous obstructions. Boarding platforms on floats shall be permitted, provided that any platform used for boarding shall not be over eighteen (18) inches in width and three (3) feet long, shall be of lightweight construction and shall not be used as a storage locker for gear exceeding, in the aggregate, fifty (50) pounds in weight.

Section 15. MAINTENANCE OF VESSEL.

a. Repairs to and maintenance of a vessel may be made or accomplished while such vessel is at its assigned berth, provided all such work is done within the confines of the vessel itself and is not carried on in any manner whatsoever upon floats, gangways or docks. Any repairs on vessels must not interfere with any other vessels. These repairs must be accomplished in the assigned berth of the owner of the vessel and not have a negative environmental effect.

b. No person shall use welding equipment, a burning torch or any other open flame apparatus without a written permit from the Berkeley Fire Department. Care must be exercised to maintain the safety of other vessels and Marina facilities, and an approved fire extinguisher of sufficient size must be readily available, as well as a water hose attached to an outlet in case of emergency.

c. An individual receiving compensation for repairing or maintaining vessels berthed at the Marina must show proper work authorization to the Marina Supervisor from the vessel's owner, as well as a City of Berkeley Business License or permit.

d. No person shall spray paint or sand blast while such vessel is in the Marina area.

Section 16. MARINA RESTRICTIONS.

a. All vessels must be equipped with approved engine mufflers, if necessary, to control noise level.

b. All vessels shall comply with applicable sections of the City of Berkeley's Uniform Fire Code, Ordinance No. 4677-N.S.

c. The owner of the vessel is legally responsible for his/her crew and guests. Unnecessary noises, including loud talking and playing of musical instruments, is prohitied from 11:00 p.m. to 7:00 a.m. Continued violation of this rule will be cause for cancellation of berthing agreement and removal of the vessel from the Marina.

d. Gates to berthing area are to be locked at all times. Blocking open or climbing over gates is prohibited.

e. Except when on board an owner's vessel, animals must be on a leash (not to exceed six (6) feet in length).

f. A person shall not willfully injure, break, remove or tamper with any part of any vessel in the Marina, nor shall any person climb into or upon any vessel without consent of the owner, unless in performance of official duties or to protect life and/or property.

g. Landing or taking off of an aircraft is prohibited except in emergency situations. No person shall land or take off any helicopter, seaplane, or other aircraft on or from any land or waters of the Marina without prior approval of the Marina Supervisor.

h. All vessels must keep a minimum of two hundred (200) feet from the Berkeley Fishing Pier, except when using the designated boat passage.

i. No structure may be built for the purpose of berthing, anchoring or mooring vessels without permission first having been secured from the Marina Supervisor.

j. Gross length of the boat, including bowsprits, rudder boom, outboard motors or other extensions, may not exceed the limits of the berth assigned.

k. Bicycles, skateboards, or similar vehicles shall not be ridden on any dock or float in the Marina.

Section 17. VESSEL TRAFFIC WITHIN THE MARINA.

All vessels approaching or within the Marina area must be operated in a safe and prudent manner and in no event shall the entrance to the Marina be blocked by general boating activities or fishing.

The speed of any vessel within the Marina shall not exceed five (5) miles per hour.

No persons shall operate a vessel upon the waters of the Marina in such a manner that the speed thereof creates an unnecessary or excessive wake, or interferes with the operation of any other vessel.

Vessels are prohibited from using the Marina waters except for departing and returning to their designated berths. (Map of Marina attached to this ordinance to show area of restricted movement.)

Section 18. SWIMMING AND/OR UNDERWATER DIVING.

It shall be unlawful for any person to swim, bathe, or wade in any portion of the Marina, except Shore Bird Park. However, this section shall not prevent an owner or his/her authorized representative from working on his/her vessel under water.

The Marina Supervisor is hereby authorized and directed to install and maintain signs in such number and at such places in said Marina as he/she shall deem necessary in order to give notice to persons that swimming, bathing and wading is prohibited therein, except at Shore Bird Park.

Section 19. CRUISING TYPE VESSELS USED AS A RESIDENCE.

No vessel berthed in the Marina shall be used as a place of residence except as authorized by the City Council. Any vessel used for overnight accommodation between the hours of 2:00 a.m. and 6:00 a.m. for more than three (3) nights in a seven (7) day period shall be considered a residence. A request in writing to the Marina Supervisor for a reasonable extension of time, i.e., vacation, temporary or visitor's berthing, or extenuating circumstances, will be considered. Written approval from the Marina Supervisor must be received prior to the fourth night of remaining on board the vessel.

To provide additional security and assistance in emergency situations, the Marina Supervisor may authorize and designate a limited number of berths, not to exceed forty (40), as residences. These berths will be designated in each berthing section, depending upon the total number of berths in that section, and will be subject to the following conditions:

a. Vessels receiving residence privileges from the Marina Supervisor must be of a cruising type, kept in good repair and in seaworthy condition. The vessels must not be permanently attached to the dock and must leave

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the Marina waters at least once for a minimum of six (6) hours each ninety (90) day period.

b. Report any emergency situation, unusual event, or violation of regulations to the Marina office.

c. The berther and three (3) members of his/her family, and one (1) other non-family member, may be permitted to use a vessel as a residence. Subleasing or renting will not be allowed. The Marina office is to be advised in writing the names and phone numbers of all persons residing on board for any period exceeding seven (7) days. If the berther is not using the vessel, the berther may allow another person to use the vessel as a residence for a period not to exceed ninety (90) days. The berther must advise the Marina office in writing prior to giving permission for another person to use the vessel as a residence.

d. Residence privileges are not transferable with the sale of the vessel. Berthers who have residence privileges may purchase a new vessel and still retain these privileges, provided that a suitable berth for the new vessel is available. A berther may place the berth on half-rate and retain residence status; however, during this period, the temporary berther does not have residence privileges.

e. The owner of a pet that creates a public nuisance will be required to remove that pet from the Marina.

f. Permission to use a vessel as a residence will be revoked if complaints are received by the Marina office about loud, boisterous, or unseemly conduct of those on board, or violation of these or other Marina regulations as set forth herein.

g. No appurtenances, or writing, may be placed on the exterior of the vessel that would detract from the normal appearance of the vessel.

h. Sewage must be controlled or contained in the following manner:

(1) Remove marine head (toilet) and seal valves and thru-hull fittings.

(2) Install self-contained marine head (toilet) such as monomatic or similar.

(3) Install approved holding tank or other device to contain sewage, with no outlet to allow tank or device to be emptied except by pumping.

(4) If marine head (toilet) remains on board, it must be physically and permanently disconnected from discharge valves or thru-hull fittings.

i. A charge of forty-five cents (45¢) per berth foot per month will be charged for additional expense of water, mail, garbage, restroom facilities and use of holding tank pump-out.

j. Vessels used as a residence located in non-metered berths will pay an additional charge for electricity. Based on P.G.&E. current rate of .02089 per kilowatt hours, vessels to thirty (30) feet will pay Ten Dollars ($10.00) per month, thirty and one/tenth (30.1) feet to thirty-nine and nine/tenths (39.9) feet will pay Twelve Dollars and Fifty Cents ($12.50) per month. All vessels of forty (40) feet or over will pay Fifteen Dolars ($15.00) per month.

k. Payments for berth rent and all other charges must be kept current. If any charges become delinquent for seventy-five (75) days, the privilege will be cancelled.

Section 20. NON-CRUISING TYPE VESSELS USED AS A RESIDENCE.

Berths H-1, 2, 5, 6, 9, and 10 and I-1, 2, 5, 6, 9, and 10 are authorized as non-cruising type vessel berths. The vessels occupying these berths are non-cruising type vessels with permanent sewer hookups and are subject to the following conditions:

a. Vessels using a berth as a residence may be rented for a period not to exceed six (6) months in any twelve (12) month period. The City Manager may permit such vessel to be rented for an additional six (6) months if he/she determines that there is good cause.

b. Non-cruising type vessels being used as a residence cannot be replaced by other non-cruising type vessels once the berth is vacated. The berth will be available for residence privileges by a cruising type vessel equipped with sewer hookups.

c. Vessels in the above listed berths, and the areas immediatly surrounding such vessels, shall be kept in a sanitary and orderly condition at all times in order to assure the preservation of the public health and safety. Failure of any person living on a vessel in the Marina to abide by such requirements shall be cause for revocation of the privilege of using such vessel for living purposes.

Section 21. SANITARY FACILITIES.

Sanitary facilities (Marina toilet, or head, sinks, etc.) shall not be used while the vessel is in the Marina unless the vessel is equipped with an approved or acceptable operating device for containment of sewage. It shall be unlawful for any person to discharge sewage or other pollutants into the waters in the Marina area.

Vessels in the Marina, and the areas immediately surrounding the vessel, shall be kept in a clean, neat and orderly condition at all times.

Failure of any person to comply with the above requirements shall cause revocation of the berth.

Section 22. CHILDREN IN MARINA.

It shall be unlawful for any child under the age of sixteen

(16) years to go, remain, or be upon any of the wharves, gangways, floats or vessels in the Berkeley Marina, unless such child is accompanied by his parent or parents, or other adult person, or unless such child has the written permission of the owner of any vessel located at the Marina to go upon such vessel.

Section 23. FISHING IN MARINA BASIN PROHIBITED.

It shall be unlawful for any person to fish in the Marina or in restricted area or from any vessel, structure, floats, docks or shoreline. (See attached map.)

Section 24. DAMAGE AND/OR LOSS OF PROPERTY.

The owner of a vessel must assume all liability for loss to his/her property of any kind while it is within the limits of the boundary of the Marina. The City of Berkeley assumes no risk on account of fire, theft, Act of God, or damages of any nature to vessels.

Section 25. VEHICLE OR TRAILER PARKING IN MARINA AREAS.

Permission from the Marina office must be obtained prior to parking any vehicle, trailer or boat in the parking areas within the Marina area for a period exceeding seventy-two (72) consecutive hours. If permission is not requested or granted, the vehicle, trailer or boat will be removed from the Marina area at the owner's expense.

Any vehicle or trailer parking in restricted areas, in limited parking areas beyond the allowed time, or in driveways will be removed from the Marina at the owner's expense.

All motor driven vehicles are prohibited on any path, sidewalk, pier, dock or float in the Marina.

The use of any vehicle for eating or sleeping for over four (4) hours per day while parked in the Marina is prohibited.

Section 26. SOLICITATION AND ADVERTISING.

a. Solicitation of patronage for private or commercial business in the Marina without a permit is prohibited. (City Ordinance No. 5017-N.S.)

b. No distribution of literature (brochures, pamphlets or other material) is permitted in the Marina area. This includes posting of signs, except as allowed by the Marina Supervisor.

c. No person shall row, propel, navigate or maintain any vessel or float in the Marina for the purpose of advertising, without first having received a permit from the Marina Supervisor for such purpose. (City Ordinance No. 5017-N.S.)

d. No sign advertising commercial use of a vessel shall be displayed on any vessel, float, dock or other structure. Properly licensed commercial vessels operating from the Marina may have the vessel's name and telephone number displayed on the vessel in an area no larger then fourteen (14) inches by thirty-six (36) inches in two (2) locations.

e. Other signs, such as for sale signs, on privately owned vessels may not exceed three (3) square feet.

Section 27. PENALTY.

Violations of this ordinance are punishable as provided in the Berkeley Municipal Code, Chapter 1.20.

Section 28. CONSTITUTIONALITY.

If any section, subsection, subdivision, paragraph, sentence, clause or phrase of this ordinance, or any part thereof, is for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this ordinance or any part thereof. The City Council hereby declares that it would have passed each section, subsection, subdivision, paragraph, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases be declared unconstitutional.

Section 29. REPEAL.

Ordinance No. 4159-N.S. and all ordinances amendatory thereof are hereby repealed.

Section 30. POSTING.

Copies of this Bill are hereby ordered published by posting with the vote thereon for two (2) days at the ten (10) prominent places in the City of Berkeley as designated by Ordinance No. 2032-N.S.

At a regular meeting of the Council of the City of Berkeley, held on the fourteenth day of March, 1978, this Bill was passed to print and ordered published by posting by the following vote:

Ayes: Councilmembers Davis, Dean, Denton, Feller, Hancock, Hone, Segesta and President Widener.

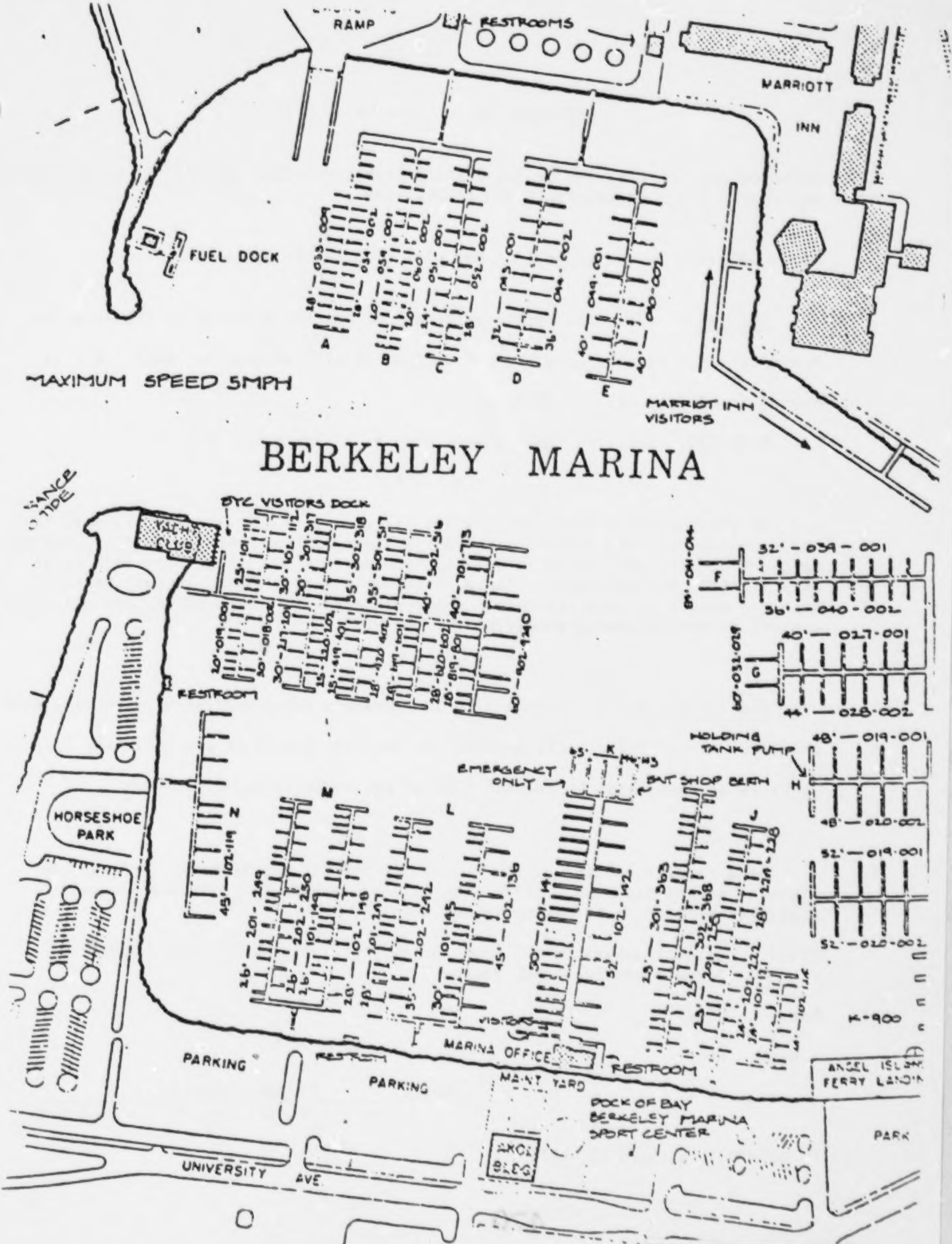
Noes: None.

Absent: Councilmember Rumford.

ATTEST: EDYTHE CAMPBELL
City Clerk and Clerk of the Council

In effect: April 27, 1978

BERKELEY MARINA


RAMP
RESTROOMS
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18'—033—009
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YACHT CLUB
RESTROOM
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32'—039—001
36'—040—002
G
40'—027—001
44'—028—002
HOLDING
TANK PUMP
H
48'—019—001
48'—020—002
52'—019—001
52'—020—002
EMERGENCY
ONLY
K
BAIT SHOP BERTH
J
N
M
L
45'—102—119
26'—201—249
45'—102—136
52'—102—142
25'—301—363
28'—224—228
HORSESHOE
PARK
VISITORS
MARINA OFFICE
RESTROOM
K-900
ANGEL ISLAND
FERRY LANDIN
PARKING
PARKING
MAINT YARD
DOCK OF BAY
BERKELEY MARINA
SPORT CENTER
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ORDINANCE NO. 5226 -N.S.

AMENDING SECTION 6.20.190 OF THE BERKELEY MUNICIPAL CODE (SECTION 19 OF ORDINANCE NO. 5032-N.S.) - MARINA RULES AND REGULATIONS.

BE IT ORDAINED by the Council of the City of Berkeley as follows:

Section 1. That the second paragraph of Section 6.20.190 of the Berkeley Municipal Code (second paragraph of Section 19 of Ordinance No. 5032-N.S.) is hereby amended to read as follows:

6.20.190. Cruising type vessels used as residences.

* * * * *

To provide additional security and assistance in emergency situations, the Marina Supervisor may authorize and designate a limited number of berths, not to exceed fifty-two (52) prior to July 1, 1980 and not to exceed forty (40) as of July 1, 1980, as residences. These berths will be designated in each berthing section, depending upon the total number of berths in that section, and will be subject to the following conditions:

* * * * *

Section 2. Copies of this Bill are hereby ordered published by posting with the vote thereon for two (2) days at the ten (10) prominent places in the City of Berkeley as designated by Chapter 1.08 of the Berkeley Municipal Code.

At a regular meeting of the Council of the City of Berkeley, held on the eleventh day of September, 1979, this Bill was passed to print and ordered published by posting by the following vote:

Ayes: Councilmembers Davis, Dean, Denton, Feller, Fukson, Hone, McDonald, Segesta and President Newport.

Noes: None.

Absent: None.

ATTEST: EDYTHE CAMPBELL
City Clerk and Clerk of the Council

In effect: February 21, 1980

ORDINANCE NO. 5226 —N.S.

Passed to Print: September 11, 1979

Finally Adopted: January 22, 1980

In Effect: February 21, 1980

At a regular meeting of the Council of the City of Berkeley, held on the eleventh day of September, 1979, this Bill was passed to print and ordered published by posting by the following vote:

Ayes: Councilmembers Davis, Dean, Denton, Feller, Fukson, Hone, McDonald, Segesta and President Newport.

Noes: None.

Absent: None.

Attest:

City Clerk and ex-officio Clerk of the Council

At a regular meeting of the Council of the City of Berkeley, held on the twenty-second day of January, 1980, this Ordinance was finally adopted by the following vote:

Ayes: Councilmembers Davis, Dean, Denton, Fukson, Hone, McDonald, Segesta and President Newport.

Noes: None.

Absent: Councilmember Feller.

Attest:

City Clerk and ex-officio Clerk of the Council of the City of Berkeley, California

Approved this 22nd day of January, 1980

Mayor and President of the Council of the City of Berkeley, California

266-546

City of Berkeley

CITY MANAGER'S OFFICE
2180 MILVIA STREET
BERKELEY, CALIFORNIA 94704

(415) 644-6580

Mr. Michael B. Wilmar, Executive Director
San Francisco Bay Conservation & Development Commission
30 Van Ness Avenue
San Francisco, CA. 94102

Dear Mr. Wilmar:

Pursuant to discussions with your office and the Berkeley Mariners Neighborhood Association, the City of Berkeley requests BCDC approval of the following minimum holding tank size standards for our authorized live-aboard vessels:

Functioning Facilities	Number of Occupants	
	1 - 2	3 - 5
Porta-Potti (no through hull fittings)	None	None
Sinks	10 gallons	15 gallons
Commodes	20 gallons	30 gallons
Shower	20 gallons	30 gallons
Washer	15 gallons	20 gallons

The tank sizes are for functioning facilities aboard a cruising type vessel, based upon number of occupants per vessel.

The total gallon size of the holding tank(s) is additive. It can be obtained by combining the number of functioning facilities on board the vessel. For example, a cruising type vessel with two sinks and one commode requires a total of a 30 gallon capacity holding tank for 1-2 residents. A total holding tank capacity of 75 gallons would be necessary for a 3-5 occupant vessel that has sinks, commodes and a shower. A vessel may have one or more holding tanks; however, each tank must be able to be pumped out and sealed from through-hull discharge.

Formal approval of this standard for minimum holding tank capacity is requested in compliance with Item II.A. of BCDC Permit No. 5-79.

Sincerely,

Forrest Craven
Acting City Manager

cc: Director of Public Works

APPENDIX D.3

MARIN COUNTY, CALIFORNIA

Chapter 11.20

MOORAGE AND OCCUPANCY OF VESSELS[2]

Sections:
11.20.010 Definitions.
11.20.020 Prohibited acts and activities.
11.20.030 Permits.
11.20.032 Mooring.
11.20.033 Drydocks.
11.20.040 Penalty for violations.
11.20.050 Severability.
11.20.060 Special fees.

11.20.010 Definitions. For the purposes of this chapter, the following phrases, words and their derivations shall have the meaning given in this section. When not inconsistent with the context, words in the present tense include the future, words in the plural number include the singular number, and words in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

(a) "Ark" is any vessel, boat, craft, or structure originally designed to float that is now permanently grounded or supported by a foundation or piling.

(b) "Director" means the duly authorized and acting director of the public works department of the county.

(c) "Floating home" is any boat, craft, living accommodation or structure supported by a means of floatation, designed to be used without a permanent foundation, which is used or intended for human habitation.

(d) "Garbage" includes any or all of the following: garbage, swill, refuse, cans, bottles, papers, vegetable matter, carcasses of dead animals, offal, trash, rubbish, and radioactive waste material.

(e) "Graywater" means wastewater from lavatories, bathtubs, showers, clothes washers, dishwashers and other similar plumbing fixtures.

(f) "Moor" means the fixing of a vessel in one location, temporarily or permanently, by mooring, anchoring, grounding, or any other means.

(g) "Person" includes any person, firm, association, corporation, or any members, agents, or employees of any of the foregoing.

(h) "Sewage" means any and all waste substance, liquid or solid, associated with human habitation, or which contains, or may be contaminated with, human or animal excreta or excrement, offal, or any feculent matter.

(i) "Transient vessel" means any vessel temporarily moored in the

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[2] Pollution of waters and public places prohibited by statute – See Health and Safety Code, Division 5, Part 2, Chapter 4.

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county which is occupied for a period of less than four consecutive days or ten days in any calendar month.

(j) "Vessel" means any watercraft of any type or size, including but not limited to barges, ferry boats, arks, yachts, houseboats, floating homes, and rafts.

(k) "Waterway" means any water, waterway, lake, river, creek, canal, lagoon, bay, inlet, slough, tributary, or arm of the sea situated within or bounding the county. (Ord. 2440 § 25, 1979: Ord. 1790 § 1, 1970: Ord. 1675 § 2, 1968: Ord. 1313 § 1, 1963).

11.20.020 **Prohibited acts and activities.** It is unlawful for any person to do any of the following:

(a) Discharge untreated sewage or graywater into a waterway;

(b) Dump or throw garbage into a waterway;

(c) Occupy, or cause, or permit another person to occupy any moored vessel as living quarters, other than a transient vessel, without first securing a valid occupancy permit as hereinafter provided;

(d) Rent or lease berthing space to any vessel other than a transient vessel, for which an occupancy permit has not been secured;

(e) Cause or allow a vessel located on or moored to his property to be occupied in contravention of this chapter for a period in excess of thirty days after receipt of a written notice from the director, specifying the vessel involved and the location thereof;

(f) Furnish or supply electrical service, natural gas or fresh water, or provide a sewer connection, to any vessel, other than transient vessels, for which an occupancy permit has not been secured. (Ord. 2440 § 26, 1979: Ord. 1790 § 2, 1970: Ord. 1371, 1964: Ord. 1313 § 2, 1963).

11.20.030 **Permits.** (a) Form–Fee. All applications for occupancy permits shall be in writing on a form supplied by the Marin County department of public works, and shall be accompanied by a nonrefundable fee as established in the current "Resolution of the Marin County Board of Supervisors Establishing Fees for Permits Administered by the Department of Public Works," to cover the cost of processing and inspection.

(b) Contents of Applications. All applications shall, as nearly as possible, contain the following information:

(1) The size, type and location of the vessel for which the permit is sought;

(2) The number of people to be accommodated on board;

(3) That provision has been made for disposal of sewage and graywater by connection to an approved shoreside sewage disposal system;

(4) That provision has been made for connection to shoreline utilities;

(5) Such other information as the chief building inspector or his authorized deputies may deem necessary to effectuate the provisions of this chapter.

(c) Issuance. If the chief building inspector, after investigation, determines that suitable provision has been made for the disposal of sewage and graywater and connection of shoreside utilities, and that occupancy of the vessel for which the permit is requested will not create a hazard to the health, welfare or safety of the occupants thereof or the community in general, he shall issue the permit. All permits may be made subject to such conditions as the chief building inspector deems appropriate to insure compliance with the provisions of this chapter.

(d) Posting. Permits shall be permanently posted and maintained upon the vessel.

(e) Term -- Renewal. All permits issued hereunder shall be effective for a period of one year; provided, however, that any material change in the conditions shown upon the application or any change in ownership or location of the vessel shall revoke the permit. Permits may be renewed by resubmission of an appropriate application and payment of a nonrefundable fee as established in the current "Resolution of the Marin County Board of Supervisors Establishing Fees for Permits Administered by the Department of Public Works," to cover the cost of processing and inspection.

(f) Inspections -- Revocation. The chief building inspector or his authorized deputies shall have the authority to board and/or inspect any vessel, after reasonable notice to the owner or occupant, when he has reasonable cause to believe that the vessel is occupied in violation of the provisions of this chapter or Chapter 19.18. The authority of the chief building inspector to board and/or enter any vessel shall be subject to the requirements and provisions of Section 19.04.023, provided the chief building inspector shall be exempt from the provisions of Section 19.04.023 and may board and/or enter any vessel in situations of emergency where public health, safety or property is endangered. The chief building inspector shall have the right to revoke any permit granted hereunder in the event that he ascertains that the permittee, or any occupant of the vessel, is acting in contravention of any of the provisions hereof.

(g) Appeal. In the event that any applicant or permittee is for any reason dissatisfied with the actions of the chief building inspector by reason of failure to grant a permit, revocation of a permit, or imposition of any conditions relating to the permit, the applicant or permittee shall have the right to appeal to the board of supervisors, in writing, within ten days after notification of the action of the chief building inspector. Upon receipt of an appeal, the board of supervisors shall call a hearing within fifteen days from receipt of the appeal and give the applicant notice thereof by registered or certified mail addressed to the appellant at the address shown on the application or permit. At the conclusion of the hearing, the board of supervisors shall render a decision, which decision shall be final. (Ord. 2451 § 5, 1980: Ord. 2449 § 4, 1980: Ord. 2440 § 27, 1979: Ord. 2209 § 3, 1976: Ord. 1793 § 1, 1970: Ord. 1790 § 3, 1970: Ord. 1675 § 3, 1968: Ord. 1371, 1964: Ord. 1313 § 3, 1963).

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11.20.032 Mooring. All vessels shall be securely and safely moored to insure the required space between floating homes, as specified in Section 11.21.050, is maintained at all times. When used, mooring lines shall be of sufficient strength and be installed in a manner that will prevent the floating home from moving more than twelve inches in any lateral direction. (Ord. 2440 § 28, 1979: Ord. 1675 § 5, 1968).

11.20.033 Drydocks. No person shall, without first securing a permit therefor from the board of supervisors, move, locate, relocate, transport or dock a floating drydock within the unincorporated area of Marin County. (Ord. 1779 § 1, 1970).

11.20.040 Penalty for violations. Any person violating any of the provisions of this chapter shall be deemed guilty of a misdemeanor and, upon conviction thereof, shall be punished as provided in Section 1.04.270. The person shall be deemed to be guilty of a separate offense for each and every day during any portion of which a violation of this chapter is committed, continued or permitted by him. (Ord. 1313 § 4, 1963).

11.20.050 Severability. If any section, subsection, subdivision, sentence, clause or phrase of this chapter is, for any reason, held to be illegal or unconstitutional, such decision shall not affect the validity of the remaining portions of this chapter. The board of supervisors hereby declares that they would have passed this chapter and each section, subsection, subdivision, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, subdivisions, sentences, clauses or phrases are declared illegal or unconstitutional. (Ord. 1313 § 6, 1963).

11.20.060 Special fees. Any vessel inspection requested for purposes not included under Section 11.20.030 shall be made by the department of public works. This inspection will be performed upon receipt of an application and fee in the manner as provided for in Section 11.20.030. (Ord. 2353 § 1, 1978).

Chapter 11.21

FLOATING HOME MARINAS

Sections:

11.21.010 Purpose.
11.21.020 Definitions.
11.21.030 Application of chapter.
11.21.040 Sewerage.
11.21.050 Mooring.
11.21.055 Mooring.
11.21.060 Access.
11.21.070 Parking.
11.21.080 Plumbing.
11.21.090 Electrical distribution.
11.21.100 Fire protection.
11.21.110 Solid waste disposal.
11.21.120 Permit required.
11.21.130 Application for permit—Fee.
11.21.140 Issuance of permit.
11.21.150 Permit posting required.
11.21.160 Term of permit—Renewal fee.
11.21.170 Revocation of permit.
11.21.180 Appeal procedure.
11.21.190 Existing marinas.
11.21.210 Penalties for violations.

11.21.010 Purpose. This chapter is enacted to provide for the health, safety and welfare of marina residents and the general community, by establishing the minimum standards required to insure the personal safety and well-being of occupants and visitors to floating homes. (Ord. 1693 § 1 (part), 1969).

11.21.020 Definitions. (a) A "floating home marina" (herein called marina) means a facility that contains one or more berthing spaces for floating homes.

(b) "Vessel" means a watercraft of any type or size, including but not limited to barges, ferryboats, arks, yachts, houseboats, floating homes and rafts. "Vessel" when used herein shall include floating homes.

(c) "Moor" means the fixing of a vessel in one location, temporarily or permanently, by mooring, anchoring, grounding or any other means.

(d) A "floating home" is any boat, craft, or living accommodation or structure supported by a means of flotation, designed to be used without a permanent foundation, which is used or intended for human habitation.

(e) "Harbormaster" is the person designated by the marina owner to control the operation of the marina.

(f) A "transient vessel" means any vessel moored in the county which is occupied for less than four consecutive days or ten days in any month. A "transient vessel" also includes any vessel for which a permit is secured from the harbormaster by the occupant stating that no sewerage will be discharged from that vessel during its occupancy. (Ord. 1693 § 1 (part), 1969).

11.21.030 Application of chapter. The provisions of this chapter shall apply to all marinas wholly or partially located within the unincorporated area of Marin County. Each marina owner shall designate a harbormaster. Marinas shall be established only where allowed by applicable zoning. Marinas which accommodate only transient vessels are exempt from the provisions of this chapter. (Ord. 1693 § 1 (part), 1969).

11.21.040 Sewerage. (1) Sewer connection. Every vessel moored at a marina shall be lawfully connected to an approved and accepted local sewer.

(2) Sewerage lateral system. Every marina shall provide a sewerage lateral for the collection of sewage from every vessel accommodated at the marina. The sewerage laterals shall be connected to a shoreside facility, shall have an inlet connection at each vessel's side, and shall be constructed, installed, and maintained in an approved manner. Connections at floating home berths shall be equipped with approved backflow prevention devices, and provide for the entrance of effluent from floating homes without reflux or back pressure.

(3) Connection to sewerage lateral system. It is unlawful for any person to use, occupy or let any vessel for human habitation unless it is lawfully connected to a sewerage system as provided above. The harbor master shall not allow occupancy of any floating home without sewerage handling facilities, as required in Chapter 19.18, within a marina under his control. (Ord. 1693 § 1 (part), 1969).

11.21.050 Mooring. The harbor master shall assure the adequacy of facilities for mooring vessels at a marina. The provisions for moorage shall comply with Section 11.20.032. Vessels shall be moored to provide a clear waterway projection between adjacent boats or floating homes of six feet on all sides. Clearance of ten feet shall be maintained when either floating home is in excess of one story. The above clearances do not apply between the vessel and the walkway or slip. Berthing areas shall be dredged to +1.5 feet mean lower low water datum and to such a depth that all floating homes are floating at a tidal stage of +5.0 mean lower low water datum. (Ord. 1693 § 1 (part), 1969).

11.21.055 Mooring. Vessels shall be moored so as to allow landward vessels unlimited access. (Ord. 2791 § 1, 1983).

11.21.060 Access. All slips or walkways providing access for more than two berthing spaces shall have a clear width of four feet. Main walkways from slips to the shore shall be five and one-half feet clear width. Any walkway or slip that extends over one hundred feet may be considered a main walkway. All public gangways (serving more than one residence) shall be designed to eliminate slopes greater than two and one-half horizontal to one vertical at any tidal stage. All public gangways shall be provided with guardrails on each side and have a clear width of four feet. All nonfloating walkways or piers shall be equipped with guardrails. All gangways and walkways shall comply with the following requirements:

(1) Gangway design live load shall not be less than thirty pounds per square foot.

(2) Guardrails must withstand a twenty-pound lateral load per linear foot of rail.

(3) Floating walkways shall serve no more than four floating homes and shall have sufficient bouyancy to support a twenty-pound-per-square-foot uniform live load, plus the dead load of the structure, without allowance for structural members in the floatation calculation.

(4) Framing shall be at least two inches nominal thickness if constructed of wood. If the entire structure is of plywood, it shall be at least three-fourths-inch thickness, marine grade, except for the portions above water which may be exterior grades.

(5) All floats or walkways shall have an identification number at berthing spaces. Identification numbers shall have standard four inch high numbers and be kept legible at all times.

(6) Piling for floating equipment shall be adequate to resist lateral forces produced by any combination of wind, current, wave, and impact.

(7) All walkways shall be lighted to provide an average illumination of 0.1 footcandles at the deck level, but in no case less than 0.05 footcandles.

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(8) Walkways serving ten or more floating homes shall be of either Type I or Type II construction or constructed in accordance with Chapter 2006 of the Uniform Building Code. (Ord. 2177 § 1, 1975: Ord. 1693 § 1 (part), 1969).

11.21.070 Parking. Parking shall be provided at all marinas as follows:

(1) Parking spaces shall be provided in conformance with Chapter 22.74.020(a);

(2) The parking area shall be paved with two inches of asphalt concrete over approved base, or approved equal;

(3) Parking areas shall be illuminated. Lighting shall provide average illumination of 0.05 footcandles on the pavement, but in no case shall be less than 0.01 footcandles;

(4) Stalls shall be clearly marked. (Ord. 1693 § 1 (part), 1969).

11.21.080 Plumbing. The plumbing of water, sewage, and gas for docks serving floating homes shall comply with the provisions of Chapter 10.04, except as follows:

(a) Water distribution. Each space for a floating home shall be supplied with a water outlet which, by means of approved connecting hoses, provides sufficient pressure and contains an approved backflow prevention device.

(b) Fuel gas piping. If floating home berths are provided with gas outlets, they shall be equipped with valve and approved disconnect couplings.

All gas piping installed on dock, piers, or other areas exposed to corrosion shall be protected by approved wrapping, or be galvanized and painted. (Ord. 1693 § 1 (part), 1969).

11.21.090 Electrical distribution. The provisions of this section cover the electrical conductors and equipment installed within, on, or above walkways or slips serving floating homes. The conductors that connect dockside power sources with the last utility connection, and all wiring running on docks and/or shore from the distribution center to the point of supply shall conform to Chapter 19.04 except as follows:

(a) Wiring system. A wiring system nominally rated 115/230 volts, three-wire AC, with grounded neutral and with a continuous means of grounding shall be used. A receptacle shall be furnished at each location intended for use by a floating home.

(b) Number of supply cords for one dwelling unit. No more than two fifty-ampere supply cords shall supply one floating home. Where the calculated load exceeds one hundred amperes the supply may be furnished by four permanently installed conductors in an approved wiring method, one conductor being identified by a continuous green color or a continuous green color with a yellow stripe.

(c) Supply from one floating home to another. No service shall be supplied from one floating home to another.

(d) Insulation of service conductors. Service conductors shall be covered with insulation which will normally withstand exposure to the atmosphere and which will prevent any detrimental leakage of current to adjacent conductors, object, or the ground. All conductors shall be insulated.

(e) Size of service conductors. Service conductors shall have adequate current-carrying capacity to conduct the current for the loads supplied safely without a temperature rise detrimental to the insulating covering of the conductors, and adequate mechanical strength.

Service conductors shall not be smaller than No. 6.

(f) Clearance of aerial conductors. No energized aerial conductor shall pass over a dock or slip, unless supported on permanently fixed poles. Minimum elevation for conductors shall be elevation +15.0 feet mean sea level datum. Clearance of ten feet shall be maintained between gangways or piers and conductors at all tidal stages. Aerial conductors shall only be used for primary service.

(g) Protected against damage. When conductors are carried down a pole, the mechanical protection shall be installed to the point required to insure against physical damage but not less than elevation +13.0 feet mean sea level datum.

(h) Service connections. No aerial service drops shall be made to floating homes with a demand of less than one hundred ten amperes.

Cords which supply floating homes shall be connected at dockside to a permanently supported receptacle enclosed in an approved manner, mounted in a manner which will insure a minimum of eighteen inches clearance above extreme high tide. If meters are used, they shall be firmly attached at the receptacle locations and protected from physical damage. Strain relief grips shall be used on all cords to relieve strain from wiring terminals.

(i) Wiring to service connection points. Service by conduit system shall be as follows:

Corrosion resistant rigid conduit shall extend from the aerial or utility supply point to the edge of the fixed portion of the pier, shore, etc. Sufficient liquid tight flexible metal conduit shall be run to the floating docks or slips to allow for extreme tidal changes with no strain on the connections. Liquid tight metal conduit shall be installed to avoid continual immersion in water. Where attached to the floating dock, the flexible conduit shall be fixed to corrosive resistant rigid metal conduit and extended to the various outlets. Plastic conduit may be used where protected and a grounding conductor is incorporated.

(j) Wet locations. All supports, bolts, straps, screws, etc., shall be of corrosive resistant materials, or protected against corrosion by approved corrosion-resistant materials. (Ord. 1693 § 1 (part), 1969).

11.21.100 Fire protection. Unless a local fire agency has established more stringent standards, a marina shall have a water system capable of

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providing two fire streams of sixty gallons per minute to any location within the marina. Fire hydrants shall be equipped with a hose and nozzle adequate to accomplish the above. Hydrant risers shall be one and one-half inches in diameter and equipped with gate valves. Systems shall be designed to provide a minimum pressure of thirty psi at hydrant risers, under flow. Systems shall be approved by the local fire authority and local water district. (Ord. 1693 § 1 (part), 1969).

11.21.110 Solid waste disposal. A system for the collection and removal of solid wastes approved by the county department of public health shall be provided at each marina. It shall be the responsibility of the harbor master to insure compliance and operation of the system. (Ord. 1693 § 1 (part), 1969).

11.21.120 Permit required. It is unlawful for any person to operate a marina or let berths for moorage of nontransient vessels without first securing a valid permit as hereinafter provided. (Ord. 1693 § 1 (part), 1969).

11.21.130 Application for permit – Fee. (a) All applications for marina permits shall be in writing on a form supplied by the county department of public works and shall be accompanied by a fee in the amount established in the current "Resolution of the Marin County Board of Supervisors Establishing Fees for Permits Administered by the Department of Public Works."

(b) All applications shall, as nearly as is possible, contain the following information:

(1) The size and location and boundaries of the marina for which the permit is sought;

(2) The number of vessels to be accommodated therein;

(3) All provision that has been made for disposal of sewage by connection to an approved shoreside sewage disposal system;

(4) All provision that has been made for connection of shoreside utilities;

(5) Certification that all applicable zoning provisions will be observed;

(6) Plans for all improvements;

(7) Such other information as the director of public works may deem necessary to effectuate the provisions of this chapter. (Ord. 2209 § 4, 1976: Ord. 1693 § 1(a), (b), 1969).

11.21.140 Issuance of permit. If the director of public works, after investigation, determines that suitable provision has been made for the disposal of sewage and connection of shoreside utilities, and that operation of the marina for which the permit is requested will not create a hazard to the health, welfare or safety of the occupants of vessels moored thereat or the community in general, he shall issue the permit. All permits may be made subject to such conditions as the director of public works deems appropriate to insure compliance with the provisions of this chapter. (Ord. 1693 § 1(c), 1969).

11.21.150 Permit posting required. Permits shall be permanently posted, displayed, and maintained at a conspicuous location in the marina. (Ord. 1693 § 1(d), 1969).

11.21.160 Term of permit – Renewal fee. All permits issued hereunder shall be effective for a period of one year; provided, however, that any material change shall revoke the permit. Permits may be renewed by resubmission of an appropriate application and payment of a fee in the amount established in the current "Resolution of the Marin County Board of Supervisors Establishing Fees for Permits Administered by the Department of Public Works." (Ord. 2209 § 5, 1976: Ord. 1693 § 1(e), 1969).

11.21.170 Revocation of permit. If the director of public works determines that a permittee is acting in contravention of any of the provisions hereof, he shall notify the permittee, in writing, of the specific provisions involved and the requirements for correction. If the permittee fails to effect compliance within the time specified in the notice, the director of public works may revoke the permit. (Ord. 1693 § 1(f), 1969).

11.21.180 Appeal procedure. In the event that any applicant or permittee is for any reason dissatisfied with the actions of the director of public works by reason of failure to grant a permit, revocation of a permit, or imposition of any conditions relating to the permit, the applicant or permittee shall have the right to appeal to the board of supervisors, in writing, within ten days after notification of the action. Upon receipt of an appeal, the board of supervisors shall call a hearing within fifteen days from receipt of the appeal and give the applicant notice thereof by registered or certified mail addressed to the appellant at the address shown on the application or permit. At the conclusion of the hearing, the board of supervisors shall render a decision, which decision shall be final. (Ord. 1693 § 1(g), 1969).

11.21.190 Existing marinas. All marinas presently operating shall apply for a permit within one month of March 25, 1969, provided, however, that the applicants who file within the requisite period shall be entitled to a period of one year from the date of application to comply with all of the provisions of this chapter. The director of public works shall have the authority to grant extensions for compliance period on certain existing marina improvements, that in their present form do not comply with the provisions of this chapter, but are not considered to be immediate hazards. The permit to be approved subject to use permit and plan approval pursuant to Chapter 22.59.045. (Ord. 1693 § 2, 1969).

11.21.210 Penalties for violations. Any person, firm or corporation violating any of the provisions of this chapter shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of the provisions of this chapter is committed, continued, or permitted and upon conviction of any such violation such person shall be punishable by a fine of not more than five hundred dollars or by imprisonment for not more than six months, or by both such fine and imprisonment.

For purpose of uniformity, this section shall be deemed to supersede any of the penalties provided in the respective codes referred to in this chapter. (Ord. 2644 § 3, 1981).

Chapter 11.22

ANCHORAGE OF VESSELS

Sections:

11.22.010 Prohibitions.
11.22.020 Exceptions.
11.22.030 Fees.

11.22.010 Prohibitions. It is unlawful to anchor, ground, moor or dock any vessel in those portions of Richardson Bay within Marin County jurisdiction, except as permitted by the board of supervisors. (Ord. 2719 § 1 (part), 1982).

11.22.020 Exceptions. The provisions of this chapter shall not apply to:

(a) Vessesl possessing permits issued by the County of Marin;

(b) Vessels moored to approved shoreside facilities or in areas covered by an approved plan;

(c) Vessels which anchor temporarily for periods of less than seventy-two hours. (Ord. 2719 § 1 (part), 1982).

11.22.030 Fees. The board of supervisors may provide, by resolution, for the imposition of permit fees for the use of approved anchorages. (Ord. 2719 § 1 (part), 1982).

Chapter 19.18

REGULATION OF THE CONSTRUCTION AND MAINTENANCE OF FLOATING HOMES

Sections:

19.18.010 Purpose.
19.18.020 Definitions.
19.18.030 Applications.
19.18.035 Permit requirements.
19.18.040 Code requirements–General.
19.18.042 Alternate construction.
19.18.045 Space requirements.
19.18.050 Height.
19.18.051 Length and width.
19.18.052 Exception and adjustment procedures for relief from height and other limitations.
19.18.060 Material.
19.18.070 Construction.
19.18.080 Ramps or horizontal exit ways.
19.18.090 Plumbing–General.
19.18.100 Building drain.
19.18.110 Plastic pipe.
19.18.120 Inboard sewage and graywater device.
19.18.130 Piping–Drainage and vents.
19.18.140 Mechanical.
19.18.150 Water distribution.
19.18.160 Fuel–Gas piping.
19.18.170 Wiring system.
19.18.180 Power supply.
19.18.190 Supply cord.
19.18.200 Second supply cord.
19.18.210 Permanent wiring.
19.18.220 Disconnecting means.
19.18.230 Branch circuit protective equipment.
19.18.240 Branch circuits.
19.18.250 Portable appliances.
19.18.260 General appliances.
19.18.270 Receptacle outlets.
19.18.280 Fixtures and appliances.
19.18.290 Wiring methods and materials.
19.18.300 Grounding.
19.18.310 Calculations.
19.18.320 Overall stability.
19.18.330 Calculations by engineer.
19.18.340 Compartmentation and flotation.
19.18.350 Fire prevention.
19.18.360 Life saving equipment.
19.18.370 Occupancy permits.

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19.18.380 Restrictions.
19.18.400 Temporary berthing permits.
19.18.410 Termination date of temporary berthing permits.
19.18.420 Plumbing.
19.18.510 Penalties for violation.

19.18.010 Purpose. This chapter is intended to protect the health, safety and welfare of floating home occupants by establishing the minimum structural, safety, health and sanitation standards for floating homes. (Ord. 1675 § 1 (part), 1968).

19.18.020 Definitions. (a) An "ark" is any vessel, boat, craft, or structure originally designed to float that is permanently grounded or supported by a foundation or piling.

(b) A "floating home" is any boat, craft, living accommodation or structure supported by a means of flotation, designed to be used without permanent foundation, which is used or intended for human habitation.

(c) "Mezzanine" is an intermediate floor placed in any story or room. If the total floor area of any mezzanine exceeds thirty-three and one-third percent of the total floor area in that room, it shall be considered as constituting an additional story.

(d) "Story" is that portion of the superstructure located between the upper surface of any deck and the upper surface of the deck or ceiling next above.

(e) "Superstructure" is that portion of a floating home or ark above the lowest deck or the level of flotation. (Ord. 2440 § 2, 1979: Ord. 2367 § 1, 1978: Ord. 1675 § 1 (part), 1968).

19.18.030 Applications. The provisions of this chapter shall apply to any floating home moored within Marin County. Nothing contained herein shall be deemed to exempt floating home occupants from complying with Chapter 11.20. (Ord. 1675 § 1 (part), 1968).

19.18.035 Permit requirements. No person shall construct a floating home, without having first secured a permit therefor from the department of public works. Application for permits shall be on a form supplied by the county and shall be accompanied by such fee as is fixed by the board of supervisors. No permit for the construction of a floating home shall be issued unless and until the owner thereof provides the county with satisfactory evidence that the floating home will be moored at a legally approved marina within Marin County.

If the floating home is to be transported to another jurisdiction, no permit shall be granted unless the owner or ship builder shall provide the county with satisfactory evidence that the floating home will, upon its completion, be transported from Marin County. In this connection, the county may require, as a condition of issuance of the permit, that the owner or ship builder furnish a suitable bond guaranteeing that the floating home will, in fact, be exported as indicated on the permit.

Any person dissatisfied with any action by the department of public works hereunder may appeal the same in writing, to the board of supervisors within ten days following the effective date of such action. (Ord. 1758 § 1, 1970).

19.18.040 Code requirements–General. Except as provided herein, each floating home or ark shall comply with the provisions of Chapter 19.04. A dwelling unit which meets the minimum requirements for an efficiency unit set forth under Chapter 12 of the 1979 Edition of the Uniform Building Code may be constructed, provided all stability design is performed in accordance with this chapter. As an alternative to the ceiling heights specified in Chapter 12 of the 1979 Edition of the Uniform Building Code, minimum ceiling heights may be six feet six inches provided that no portion of the ceiling is less than six feet six inches and that floor areas comply with Section 19.18.045(b) of the Marin County Code. (Ord. 2440 § 3, 1979: Ord. 1675 § 1 (part), 1968).

19.18.042 Alternate construction. Alternate materials and methods of construction may be allowed as provided in Chapter 1 of the 1979 Edition of the Uniform Building Code, adopted by Chapter 19.04. The building official may approve any such alternate use of salvaged material and lumber manufactured by the floating home owner provided the building official finds that the proposed design is satisfactory and complies with the provisions of Chapter 23 of the Uniform Building Code, and that the material, method, or work offered is, for the purpose intended, at least the equivalent of that prescribed in this Code in quality, strength, effectiveness, fire resistance, durability, and safety. All data required by the building official in order to determine these equivalents shall be provided by the applicant. (Ord. 2440 § 4, 1979: Ord. 1675 § 1 (part), 1968).

19.18.045 Space requirements. Each floating home or ark shall be required to comply with the following space requirements:

(a) Habitable rooms or spaces shall have an average ceiling height of six feet three inches. No portion of any room with a ceiling height of less than five feet shall be included in computing the minimum areas specified in subsection (b).

(b) A minimum of one hundred square feet of habitable floor space shall be provided. An additional seventy square feet of habitable floor space shall be provided for each occupant in excess of one. "Habitable space" is defined in the 1979 Edition of the Uniform Building Code. (Ord. 2440 § 5, 1979: Ord. 1675 § 1 (part), 1968).

19.18.050 Height. The height of a floating home or ark shall not exceed sixteen feet as measured from the water line; provided that:

(a) If its hull is composed of wood or styrofoam or similar material

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approved by the department of public works, the height shall not exceed eighteen feet; and

(b) There may be a deviation from the foregoing height allowed by the planning director upon presentation of evidence showing that the floating home or ark has special design features that accomplish the objectives of:

1. Avoiding blocky or massive appearances within marinas, and

2. Obtaining adequate open space and viewsheds both within and to the marina;

(c) Such deviation from these standards will not violate the intent of Chapters 11.24 and 19.18;

(d) No part of any such deviation shall extend in excess of twenty feet above the water line; and

(e) Such deviation shall not be for the purpose of obtaining an additional story of living or storage space. (Ord. 2451 § 1, 1980: Ord. 2449 § 1, 1980: Ord. 2440 § 6, 1979: Ord. 2367 § 2, 1978: Ord. 1675 § 1 (part), 1968).

19.18.051 Length and width. The basic floor area of a floating home shall not exceed forty-six feet in length and twenty feet in width, and that the length and width shall be subject to any greater limits on length and width that may be applicable pursuant to Section 11.21.050 of this code. The floor area of any story above the lowest story of the superstructure shall not exceed eighty percent of the story immediately below said story. All deck areas must be unencumbered by walls or roof structures. As used in this section, "basic floor area" means that area defined by the perimeter walls of a horizontal cross section through the lowest story of the superstructure with "superstructure" defined in Section 19.18.120 of the Marin County Code. (Ord. 2582 § 1, 1980: Ord. 2451 § 2, 1980: Ord. 2449 § 2, 1980).

19.18.052 Exception and adjustment procedures for relief from height and other limitations. An owner or occupant of a floating home may apply to the zoning administrator for an exception or adjustment from relief of the strict application of the requirements of Sections 19.18.050 and 19.18.051. An application for relief shall be made in the form of a written application obtainable from the planning department. A fee shall be charged the applicant for the cost of administering, noticing and processing the application, which fee shall be set annually by resolution of the board of supervisors. Upon receipt of any such application, the zoning administrator shall set a tentative time wherein action will be taken on the application. Notice of the time and hearing on the application shall be provided to all persons with temporary or floating home occupancy permits within the immediate vicinity of the berth or intended berth of the subject floating home and as are on file with the department of public works. Notices shall also be posted on the dock in which the floating home is berthed. Distribution and posting of notices shall be the responsibility of the Marin County marine inspector.

In order for exception or adjustment to be granted, the zoning administrator shall establish that the following factual circumstances prevail:

1. The requested exception will not adversely diminish or substantially reduce:

a. Light and ventilation to floating homes berthed adjacent to the proposed floating home;

b. Existing views and/or view corridors enjoyed by owners or tenants of neighboring or adjacent floating homes and floating home sites. For the purpose of this section the term "neighborhood" is intended and construed to mean the owners, occupants and/or lease-holders of floating homes or floating home berths in the general vicinity of the berth site for which exception has been requested. The term "neighborhood," is not, nor shall it be construed to mean the owners or occupants of land-based properties or improvements thereon.

2. The size (length, width and height) of the requested exception is:

a. Comparable and compatible with the size of neighboring floating homes;

b. Properly designed and fully engineered;

c. Within the spatial limitations of its intended berth and will not encroach into any fairway, adjoining berth or any required open space.

3. The exception requested is the minimum necessary to satisfy the objectives sought by the owner and/or builder of the floating home.

4. The grant of exception will not prove of any detriment to other floating homes in the immediate vicinity of the proposed floating home.

The zoning administrator shall make a decision on the said application for exception within sixty days after the application has been deemed complete by the planning department. The planning department shall consult with the county marine inspector prior to the hearing on the application for any comments or concerns the marine inspector may wish to address with respect to the application.

Any person dissatisfied with the decision of the zoning administrator may appeal to the board of supervisors. Appeals must be in writing accompanied by a fee in the amount which shall be set annually by resolution of the board of supervisors, and filed within ten working days following the decision. The board shall act upon such appeal within thirty days from the filing thereof and may sustain, modify, or overrule any decision of the zoning administrator. The decision of the board of supervisors shall be final. The board of supervisors shall have the power to decide any questions involving the interpretation of any provision of this section. (Ord. 2667, 1981: Ord. 2451 § 3, 1980: Ord. 2449 § 3, 1980).

19.18.060 Material. All material such as decking, siding, and subflooring, which is subjected to moisture or water splash shall be of a type not adversely affected by moisture, or shall be treated. (Ord. 1675 § 1 (part), 1968).

19.18.070 Construction. (a) Flooring, wall and flotation shall be designed and constructed by use of diaphragm walls in such a manner that the

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superstructure acts as an independent unit and is not adversely affected by point reactions under the flotation.

(b) Floating homes and arks shall comply with the residential energy regulations set forth in paragraph T20-1401, Article 1, Part 6, Title 24 of the California Administrative Code. (Ord. 2440 § 7, 1979: Ord. 1675 § 1 (part), 1968).

19.18.080 **Ramps or horizontal exit ways.** Ramps shall be not less than thirty-six inches in width, exclusive of required handrails which shall not reduce the width more than three and one-half inches. The ramp or gangway slope shall not exceed three horizontal to one vertical at any stage of the tide.

Ramps or horizontal exits, other than mooring docks, shall be provided with two handrails or guard railings.

Railings shall be designed to withstand a twenty-pound lateral live load along the top rail. Railings shall be not less than thirty-six inches in height above the ramp floor, and in open-type railings intermediate members shall not be spaced more than nine inches apart.

Private ramps or horizontal exits shall be capable of carrying a live load in accordance with the following schedule:

LIVE LOAD	LENGTH OF RAMP BETWEEN SUPPORTS
50 psf	0 to 5 feet
40 psf	5 feet to 10 feet
30 psf	Over 10 feet

Ramp design shall also include dead load. Minimum framing members shall be two inches by four inches if constructed of wood.

All ramps and horizontal exits shall have exit illumination with minimum intensity of one footcandle at floor level of entry or one-tenth footcandle on walkway or ramp. Alternate materials and methods of construction may be allowed as provided in Chapter 19.04 of this code. (Ord. 2440 § 8, 1979: Ord. 1675 § 1 (part), 1968).

19.18.090 **Plumbing–General.** It is the intent of these provisions that, except as may be otherwise expressly authorized by local public health agencies, water quality control agencies, and the San Francisco Bay Conservation and Development Commission, that there be no discharge of sewage or graywater from floating homes or arks into the waters within the jurisdiction of the county.

The plumbing of all floating homes, arks, and dockside facilities shall comply with Chapter 19.04, except as hereinafter provided. (Ord. 2440 § 9, 1979: Ord. 1675 § 1 (part), 1968).

19.18.100 **Building drain.** The "building drain" is that part of the lowest piping of a drainage system which receives the discharge from all soil, resistance, durability, and safety. All data required by the building official in order to determine these equivalents shall be provided by the applicant. (Ord. 2440 § 4, 1979: Ord. 1675 § 1 (part), 1968).

19.18.045 Space requirements. Each floating home or ark shall be required to comply with the following space requirements:

(a) Habitable rooms or spaces shall have an average ceiling height of six feet three inches. No portion of any room with a ceiling height of less than five feet shall be included in computing the minimum areas specified in subsection (b).

(b) A minimum of one hundred square feet of habitable floor space shall be provided. An additional seventy square feet of habitable floor space shall be provided for each occupant in excess of one. "Habitable space" is defined in the 1979 Edition of the Uniform Building Code. (Ord. 2440 § 5, 1979: Ord. 1675 § 1 (part), 1968).

19.18.050 Height. The height of a floating home or ark shall not exceed sixteen feet as measured from the water line; provided that:

(a) If its hull is composed of wood or styrofoam or similar material approved by the department of public works, the height shall not exceed eighteen feet; and

(b) There may be a deviation from the foregoing height allowed by the planning director upon presentation of evidence showing that the floating home or ark has special design features that accomplish the objectives of:

1. Avoiding blocky or massive appearances within marinas, and
2. Obtaining adequate open space and viewsheds both within and to the marina;

(c) Such deviation from these standards will not violate the intent of Chapters 11.24 and 19.18;

(d) No part of any such deviation shall extend in excess of twenty feet above the water line; and

(e) Such deviation shall not be for the purpose of obtaining an additional story of living or storage space. (Ord. 2451 § 1, 1980: Ord. 2449 § 1, 1980: Ord. 2440 § 6, 1979: Ord. 2367 § 2, 1978: Ord. 1675 § 1 (part), 1968).

19.18.051 Length and width. The basic floor area of a floating home shall not exceed forty-six feet in length and twenty feet in width, and that the length and width shall be subject to any greater limits on length and width that may be applicable pursuant to Section 11.24.050 of this code. The floor area of any story above the lowest story of the superstructure shall not exceed eighty percent of the story immediately below said story. All deck areas must be unencumbered by walls or roof structures. As used in this section, "basic floor area" means that area defined by the perimeter walls of a horizontal cross section through the lowest story of the superstructure with "superstructure" defined in Section 19.18.120 of the Marin County Code. (Ord. 2582 § 1, 1980: Ord. 2451 § 2, 1980: Ord. 2449 § 2, 1980).

19.18.052 Variance and adjustment procedures for relief from height and other limitations. (a) An owner or occupant of a floating home may apply to the zoning administrator for a variance or adjustment for relief from strict applications of the requirements of Sections 19.18.050 and 19.18.051. An application for relief shall be made in the form of a written application obtainable from the zoning administrator. A fee of two hundred dollars and a categorical exemption fee of twelve dollars and fifty cents shall be charged the applicant for cost of administration, mailing and processing. Upon receipt of any such application, the zoning administrator shall set a time and place for hearing thereon. Notice of the time and place of hearing shall be mailed to all persons with temporary berthing or floating home occupancy permits on file with the department of public works and whose floating homes or arks are berthed on docks immediately adjacent to or at the same dock as the floating home to which any such application applies. The zoning administrator shall also cause to be posted a notice of the time and hearing on the dock in which the floating home is berthed. It shall be necessary that the zoning administrator find the following facts with respect thereto:

(1) That because of special circumstances applicable to subject floating home, including size, shape, location or surroundings, the strict application of Sections 19.18.050 and/or 19.18.051 is found to deprive subject floating home of privileges enjoyed by other floating homes or arks in the proximity to the affected floating home;

(2) That the variance or adjustment is necessary for the preservation and enjoyment of a substantial property right of the applicant;

(3) That the granting of the variance or adjustment will not be detrimental to the public welfare or injurious to other floating homes or arks in the area in which the floating home is berthed.

(b) Any variance or adjustment granted under the provisions of this section shall be subject to such conditions as will assure that such does not constitute a grant of special privilege inconsistent with the limitations upon other floating homes or arks in proximity to the affected floating home where the subject floating home is berthed.

(c) The zoning administrator shall make his decision on the application within sixty days after the filing of the application or within such longer period as may be agreed upon between the applicant or his agent and the zoning administrator.

(d) In granting any adjustment or variance under the provisions of this section, the zoning administrator shall designate such conditions in connection therewith as will, in his opinion, secure substantially the objectives of the provision to which such adjustment or variance is granted, as to light, air and the public health, safety, comfort, convenience and general welfare. In all cases in which adjustments or variances are granted under the provisions of this section, the zoning administrator shall require such evidence and guarantees as he may deem to be necessary that the conditions designated in connection therewith are being and will be complied with.

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(e) Any person dissatisfied with the decision of the zoning administrator may appeal to the board of supervisors. Appeals must be in writing accompanied by a fee in the amount of seventy-five dollars, and filed within ten working days following the decision. The board shall act upon such appeal within thirty days from the filing thereof and may sustain, modify, or overrule any decision of the zoning administrator. The decision of the board of supervisors shall be final. The board of supervisors shall have the power to decide any questions involving the interpretation of any provision of this section. (Ord. 2451 § 3, 1980: Ord. 2449 § 3, 1980).

19.18.060 **Material.** All material such as decking, siding, and subflooring, which is subjected to moisture or water splash shall be of a type not adversely affected by moisture, or shall be treated. (Ord. 1675 § 1 (part), 1968).

19.18.070 Construction. (a) Flooring, wall and flotation shall be designed and constructed by use of diaphragm walls in such a manner that the superstructure acts as an independent unit and is not adversely affected by point reactions under the flotation.

(b) Floating homes and arks shall comply with the residential energy regulations set forth in paragraph T20-1401, Article 1, Part 6, Title 24 of the California Administrative Code. (Ord. 2440 § 7, 1979: Ord. 1675 § 1 (part), 1968).

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Railings shall be designed to withstand a twenty-pound-lateral live load along the top rail. Railings shall be not less than thirty-six inches in height above the ramp floor, and in open-type railings intermediate members shall not be spaced more than nine inches apart.

Private ramps or horizontal exits shall be capable of carrying a live load in accordance with the following schedule:

LIVE LOAD	LENGTH OF RAMP BETWEEN SUPPORTS
50 psf	0 to 5 feet
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Ramp design shall also include dead load. Minimum framing members shall be two inches by four inches if constructed of wood.

All ramps and horizontal exits shall have exit illumination with minimum intensity of one footcandle at floor level of entry or one-tenth footcandle on walkway or ramp. Alternate materials and methods of construction may be allowed as provided in Chapter 19.04 of this code. (Ord. 2440 § 8, 1979: Ord. 1675 § 1 (part), 1968).

19.18.090 Plumbing—General. It is the intent of these provisions that, except as may be otherwise expressly authorized by local public health agencies, water quality control agencies, and the San Francisco Bay Conservation and Development Commission, that there be no discharge of sewage or graywater from floating homes or arks into the waters within the jurisdiction of the county.

The plumbing of all floating homes, arks, and dockside facilities shall comply with Chapter 19.04, except as hereinafter provided. (Ord. 2440 § 9, 1979: Ord. 1675 § 1 (part), 1968).

19.18.100 Building drain. The "building drain" is that part of the lowest piping of a drainage system which receives the discharge from all soil, waste and other drainage pipes inside the walls of the unit and conveys it to a sewage device which conforms to Section 19.18.120 of this chapter. (Ord. 1675 § 1 (part), 1968).

19.18.110 Plastic pipe. Plastic pipe for use in piping of the potable water supply, drainage systems and venting, shall be in accordance with the 1979 Edition of the Uniform Plumbing Code, adopted by Marin County Code Chapter 19.04. (Ord. 2440 § 10, 1979: Ord. 1675 § 1 (part), 1968).

19.18.120 Inboard sewerage and graywater device. (a) A sewage and graywater receiving tank and ejector device shall be installed in every floating home. Said device shall consist of a tank with a liquid capacity of not less than thirty gallons, nor more than forty gallons. Said device must connect to the local sewerage lateral system. The pump horsepower (H.P.) rating, type and outlet size shall be approved by the Marin County department of public works and the local sanitary district.

(b) Arks shall be connected to the local sewage disposal system. The connection to the disposal system and method used to move the sewerage from the ark to the local system shall be approved by the sanitary district and the county. (Ord. 2440 § 11, 1979: Ord. 1675 § 1 (part), 1968).

19.18.130 Piping–Drainage and vents. ABS-DWV may be used for drainage systems and vent piping. (Ord. 1675 § 1 (part), 1968).

19.18.140 Mechanical. All mechanical devices and systems shall comply with the 1979 Edition of the Uniform Mechanical Code adopted by Marin County Code, Chapter 19.04.

Heating for floating homes may be supplied by wood burning fireplaces or stoves; oil-fired appliances; electrical heating appliances; or solar energy where the applicant furnishes satisfactory evidence to the chief building inspector that a minimum temperature of seventy degrees can be maintained and that the installation of the heating device will comply with Sections 601 and 704.8 of the Uniform Mechanical Code. (Ord. 2440 § 12, 1979: Ord. 1675 § 1 (part), 1968).

19.18.150 Water distribution. Water shall not be piped to supply floating homes or arks through flexible hose unless the hose is a high-pressure type terminating in approved connectors and is preceded by an approved backflow prevention device. No hose shall run exposed on docks, piers, floating homes or arks. The length of the hose shall not exceed fifty feet.

Plastic pipe for use in piping of potable water supply shall be PVC type 2 high impact, schedule 40 or higher. PVC shall bear the UPC label and/or the N.S.F. approval. PVC shall not be threaded in the field. Cleaning and cementing of joints shall be as directed by the manufacture. (Ord. 2440 § 13, 1979: Ord. 1675 § 1 (part), 1968).

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19.18.160 Fuel-Gas piping. All gas piping installed in a floating home or ark which is exposed to corrosion shall be galvanized, primed and painted or wrapped and installed in accordance with the provisions of the 1979 Edition of the Uniform Plumbing Code.

Dockside gas connections to floating homes or arks shall be made with approved high pressure hose and terminate in approved positive disconnect couplings. Gas hoses shall not where subject to physical damage run exposed on docks, piers, floating homes or arks. The hose length shall not exceed fifty feet. (Ord. 2440 § 14, 1979: Ord. 1675 § 1 (part), 1968)

19.18.170 Wiring system. A wiring system nominally rated 115/230 volts, 3 wire AC, 3 pole 4 wire grounding type shall be in all floating homes that use shore power. Arks shall be 115/230 volt, 3 wire AC with grounded neutral. (Ord. 2451 § 4, 1980: Ord. 2440 § 15, 1979: Ord. 1675 § 1 (part), 1968).

19.18.180 Power supply. (a) The service provided to an ark located within twenty feet of the shoreline shall be installed in accordance with the 1978 Edition of the National Electrical Code for a land based structure. If the ark is more than twenty feet from the shoreline, service shall be provided and installed as specified for a floating home.

(b) Service equipment and meter for a floating home shall be located adjacent to it (on pier or floating dock) and shall not be mounted on the floating home.

(c) The power supply to the floating home shall be comprised of feeder circuits consisting of not more than two floating home supply cords, each rated at the amperage provided. (Ord. 2440 § 16, 1979: Ord. 1675 § 1 (part), 1968).

19.18.190 Supply cord. Each floating home or ark supply cord shall be approved and have four conductors, one of which shall be identified by a continuous green color with a yellow stripe. The attachment plug, connectors and mating receptacles shall be three pole, four wire grounding types covered by American Standards C 73 attachment plug and receptacles. The power supply cord shall be permanently attached to the distribution panel. A suitable clamp or equivalent shall be provided at the distribution panel to afford strain relief for the cord in order to prevent strain at the terminals. The length of the power supply cord shall not exceed fifty feet. (Ord. 2440 § 17, 1979: Ord. 1675 § 1 (part), 1968).

19.18.200 Second supply cord. Where the calculated load of the floating home or ark is in excess of the available amperage from a single supply cord, or where a separately metered appliance is installed in the floating home or ark, a second floating home, or ark, supply cord may be installed but only if a second serving point is available and provided. (Ord. 2440 § 18, 1979: Ord. 1675 § 1 (part), 1968).

19.18.210 Permanent wiring. Where the calculated load exceeds one hundred amperes or permanent feeder is used, the supply shall be effected by means of four permanently installed conductors in an approved wiring method, one conductor being identified by a continuous green color or a continuous green color with a yellow stripe. (Ord. 1675 § 1 (part), 1968).

19.18.220 Disconnecting means. A disconnecting means shall be provided on the exterior of each floating home or ark using approved service entrance equipment, consisting of circuit breakers, or a switch and fuses and their accessories, installed in a location that is readily accessible from the pier, dock, or float, and is near the point the supply cord or conductors enter the floating home or ark. This equipment shall have an ampere rating suitable for the load and no greater than the capacity of the supply cord. The main circuit breaker or fuses shall be plainly marked "MAIN."

This equipment shall contain solderless type of grounding connector or bar for the purpose of grounding with sufficient terminals for all grounding conductors. The neutral bar termination of the grounded circuit conductors shall be insulated.

The distribution equipment shall be located a minimum of twenty-four inches from the bottom of such equipment to the floor level or deck.

Where more than one power supply cord is installed, disconnecting means shall be provided for each cord and shall be permitted to be combined in a single equipment, but without electrical interconnections other than for grounding purposes.

Plug fuses and fuse holders shall be tamper resistant, type "S" enclosed in dead front panels. (Ord. 2440 § 19, 1979: Ord. 1675 § 1 (part), 1968).

19.18.230 Branch circuit protective equipment. Branch circuit distribution equipment shall be installed in each floating home and shall include overcurrent protection for each branch circuit, whether circuit-breakers or fuses.

If circuit-breakers are provided for branch circuit protection, two hundred thirty volt circuits shall be protected by two pole common (or companion trip), or handle-tied paired, circuit-breakers.

The branch-circuit overcurrent devices shall be rated:

(a) Not more than the circuit conductors; and

(b) Not more than one hundred fifty percent of the rating of a single appliance rated ten amperes or more; but

(c) Not more than the fuse size marked on the air conditioner or other motor operated appliance. (Ord. 1675 § 1 (part), 1968).

19.18.240 Branch circuits. The number of branch circuits required shall be determined in accordance with the following:

Based on three watts per square foot, times outside dimensions of the enclosed area of the floating home, excluding decks and porches, divided by one hundred fifteen volts, to determine number of fifteen or twenty ampere lighting area circuits, e.g.,

$$\frac{3 \times \text{Length} \times \text{Width}}{115 \times 15 \text{ (or 20)}} + \text{Number of 15 (or 20 ampere circuits.)}$$

(Ord. 1675 § 1 (part), 1968).

19.18.250 **Portable appliances.** A minimum of two twenty-ampere branch circuits shall be required for receptacle outlets in the kitchen area, which may also supply other receptacle outlets in the dining, and deck area. These circuits shall supply only portable appliances. A washing machine shall be on a separate twenty ampere circuit. (Ord. 1675 § 1 (part), 1968).

19.18.260 **General appliances.** (Including furnace, water heater, range, and central or room air conditioner, etc.) One or more circuits of adequate rating shall be required in accordance with the following:

(a) For fixed appliances on a circuit, without lighting outlets, the sum of rated amperes shall not exceed the branch circuit rating for other than motor loads or eighty percent of the branch circuit rating for air conditioning.

(b) The rating of a single portable appliance on a circuit with no other outlets shall not exceed eighty percent of the circuit rating.

(c) The rating of range branch circuit shall be based on the range demand as specified for ranges in Section 19.18.310(b)5. (Ord. 1675 § 1 (part), 1968).

19.18.270 Receptacle outlets. All receptacle outlets shall be the grounding type and must be installed in accordance with Chapter 19.04 of this code. Receptacles shall be parallel blade, fifteen ampere, one hundred twenty-five volt, either single or duplex, and shall contain an individual grounding type outlet for each cord-connected fixed appliance installed.

Except in the bath and hall areas, receptacle outlets shall be installed at wall spaces two feet wide or more, so that no point along the floor line is more than six feet, measured horizontally, from an outlet in that space, except as explained in the following. Receptacle outlets are not required for wall spaces occupied by kitchen or wardrobe cabinets.

In addition, a receptacle outlet shall be installed:

(a) Over counter type tops in the kitchen (at least one on each side of the sink if counter tops are on each side);

(b) Adjacent to the refrigerator and free-standing gas range space.

(c) At counter top spaces for built-in vanities;

(d) At counter top spaces under wall-mounted cabinets. Receptacle outlets shall not be installed within or adjacent to a shower or bathtub space. (Ord. 1675 § 1 (part); December 10, 1968).

19.18.280 Fixtures and appliances. (a) Water heaters, refrigerators, air conditioning equipment, ranges, electric heaters, washer, dryers and other similar appliances shall be an approved type, connected in an approved manner, and securely fastened in position. (See Section 19.18.300 for provisions on grounding)

(b) Specifically approved pendant type fixtures or pendant cords may be installed in floating homes.

(c) If a lighting fixture is provided over a bathtub or in a shower stall, it shall be an approved enclosed and gasketed type.

(d) Switches shall not be located inside the tub or shower space. (Ord. 1675 § 1 (part); December 10, 1968).

19.18.290 Wiring methods and materials. Except as provided in this section wiring methods and materials required by Chapter 19.04 shall be used in floating homes.

(a) Nonmetallic outlet boxes are acceptable only in conjunction with nonmetallic sheathed cable.

(b) Nonmetallic cable located below seven feet six inches above the floor, if exposed, shall be protected from physical damage by covering boards, guard straps, or conduit.

(c) Metal clad and nonmetallic cables may be passed through the centers of the wide side of two by four studs. However, they shall be protected where they pass through two by two studs or at other studs or frames where the cable or armour would be less than one and one-half inches from the inside or outside surface. Steel plates on each side of the cable, or a tube with not less than No. 16 manufacturer's standard gauge wall thickness, are required to protect the cable. These plates or tubes shall be se-

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curely fastened in place.

(d) If metallic faceplates are used, they shall be effectively grounded.

(e) If a range, clothes dryer, or similar appliance is connected by armored cable or flexible conduit, a length of free cable or conduit should be provided to permit movement of the appliance. The cable or flexible conduit should be adequately secured to the wall. Clearance space behind a range may provide the required protection if a range is connected by type SE cable. When used, type SE cable shall have an identified and insulated neutral plus an equipment grounding conductor. Nonmetallic cable (type NM) shall not be used to connect a range.

(f) Rigid metal conduit shall be provided with a locknut inside and outside the box. A conduit bushing shall be used on the inside. Inside ends of the conduit shall be reamed.

(g) Switches shall be rated as follows:

(1) Lighting circuit switches shall have a ten ampere, one hundred twenty-five volt rating, or higher if required for the connected load.

(2) Motor or other load switches shall have ampere or horsepower ratings or both, adequate for loads controlled. (An "AC general use" snap switch may control a motor two horsepower or less if full load current is not over eighty percent of the switch ampere rating)

(h) At least four inches of free conductor shall be left at each outlet box unless conductors are intended to loop without joints.

(i) WIRING EXPOSED TO WEATHER. (1) If outdoor wiring is exposed to moisture or physical damage, it shall be protected by rigid metal conduit or liquid-tight flexible metal conduit. Electrical metallic tubing may be used when closely routed against frames and equipment enclosures.

(2) Conductors shall be Type NMC, RW, TW, or equivalent. (Ord. 1675 § 1 (part); December 10, 1968).

19.18.300 Grounding. Grounding of electrical and non-electrical metal parts in a floating home shall be effected through connection to a grounding bus in the floating home distribution panel. The grounding bus shall be grounded through the green conductor in the supply cord, or the feeder wiring to the service ground in the service entrance equipment.

(a) INSULATED NEUTRAL

(1) The grounded circuit conductor (neutral) shall be insulated from the grounding conductors, equipment enclosures, and other grounded parts. The grounded (neutral) circuit terminals in distribution panels, ranges, clothes dryers, counter mounted cooking units, and wall mounted ovens are to be insulated from the equipment enclosure. Bonding screws, straps, or buses in distribution panels and/or appliances are to be removed and discarded.

(2) Ranges and clothes dryers shall be connected with four conductor cord and three pole four wire grounded type plugs, or by armored cable or conductors enclosed in flexible steel conduit.

(b) EQUIPMENT GROUNDING MEANS

(1) The green grounding wire in the supply cord or permanent feeder wiring shall be connected to the grounding bus in the distribution panel or disconnecting means.

(2) The chasis, if metal, shall be grounded. The grounding conductor may be solid or stranded, insulated or bare, and shall be an armored grounding conductor or routed in conduit if No. 8 AWG. The conductor, if No. 6 AWG or larger, may be run without metal covering. The grounding conductor shall be connected between distributing panel grounding terminal and a terminal on the chassis. Grounding terminals shall be of the solderless type and approved as pressure terminal connectors recognized for the wire size employed.

(3) In the electrical system, all exposed metal parts, enclosures, frames, lamp fixtures, canopies, etc., shall be effectively bonded to the grounding terminal or enclosure of the distribution panel.

(4) Cord connected appliances, such as washing machines, clothes dryers, refrigerators, and the electrical system of gas ranges, etc., shall be grounded by means of an approved cord with grounding conductor and grounding type plug.

(c) GROUNDING OF NON-CURRENT CARRYING METAL PARTS

All major exposed metal parts that may become energized, including the water, gas, and waste plumbing, the roof and outer metallic covering, the chassis and metallic circulating air ducts, shall be effectively bonded to the grounding terminal or enclosure of the distribution panel or to the metal chassis. Bonding of the chassis to the distribution panel grounding terminal shall be effected in accordance with Section 19.18.300(b)2. (Ord. 1675 § 1 (part); December 10, 1968).

19.18.310 Calculations. The supply cord and distribution panel load for each power supply assembly in a floating home shall be computed on the basis of a three wire, 115/230 volt supply with one hundred fifteen volt loads balanced between the two legs of the three wire system, as follows:

(a) LIGHTING AND SMALL APPLIANCE LOAD

LIGHTING WATTS: Length times width of floating home (outside dimensions) times three watts per square foot; e.g.,

Length x width x 3 = Lighting watts.

SMALL APPLIANCE WATTS: Number of circuits times fifteen hundred watts for each twenty ampere appliance receptacle circuit; e.g.,

Number of circuits x 1500 = Small appliance watts.

Total: Lighting watts plus small appliance—Total watts.

First three thousand total watts at one hundred percent plus remainder at 35 percent = watts o be divided by two hundred thirty volts to obtain current (amperes) per leg.

(b) Total load for determining power supply is the summation of:

(1) Lighting and small appliance load as calculated in Section 19.18.310(a).

(2) Nameplate amperes for motors and heater loads—exhaust fans, air conditioners*, electric, gas or oil heating.

*Omit smaller of these two, except blower motor if used as air conditioner evaporator motor.

(3) Twenty-five percent of current of largest motor in (2)

(4) Total of nameplate amperes for: disposal, dishwasher, water heater, clothes dryer, wall mounted oven, cooking units. If the number of these units exceeds three, use seventy-five percent of total.

(5) Amperes for free standing range (as distinguished from separate ovens and cooking units) shall be determined by dividing values below by two hundred thirty volts.

Nameplate Rating	Use
10,000 w x or less	80 percent of rating
10,001-12,500 w	8,000 w
12,501-13,500	8,400
13,501-14,500	8,800
14,501-15,500	9,200
15,501-16,500	9,600
16,501-17,500	10,000

(6) If outlets or circuits are provided for other than assembled appliances, pumps, etc., the anticipated loads must be included; e.g.,

Example:

A floating home is thirty-five by twenty and has two portable appliance circuits, a one thousand watt, two hundred thirty volt heater; a two hundred watt, one hundred fifteen volt exhaust fan; two hundred watt, one hundred fifteen volt dishwasher and seven thousand watt electric range.

Lighting and small appliance load
Lighting 35 x 20 x 3 = 2,100 watts
Small appliance 1,500 x 2 = 3,000 watts
5,100 watts

1st 3,000 watts at 100% 3,000
Remainder (5,100 — 3,000 = 2,100) at 35% 735
3,735

3,735 ÷ 230 = 16 amperes per leg
1,000 watt (heater) ÷ 230 = 4.4 amp
200 watt (fan) ÷ 115 = 1.7 amp
400 watt (dishwasher) ÷ 115 = 3.5 amp
7,000 watt (range) x .8 ÷ 230 = 24. amp
Amperes per Leg

	A	B
Lighting and appliances		
Heater (230 volt)	16	16
Fan (115 volt)	4	4
Dishwasher (115 volt)	2	- -
Range	—	4
	24	24
Total	46	48

Based on higher current calculated for either leg, use one fifty ampere supply cord. (Ord. 1675 § 1 (part), 1968).

19.18.320 Overall stability. The floating home shall be stable with both dead load and live load included.

(a) METACENTRIC HEIGHT

The metacentric height (MG) shall be equal to + 1.0 foot or more according to the following equation:

$$(MG) = \frac{W_s \; I_y}{W} - L$$

where:

W_s = unit weight of sea water

W = total weight of floating home including dead load and live load. (L.L. = twenty pounds per square foot of first floor area, and ten pounds per square foot of second floor, habitable attic or loft)

I_y = Moment of inertia of the area encompassed by the waterline around the hull or flotation (fully loaded boat) as taken about the longitudinal axis of the floating home.

L = The distance between the center of gravity and the center of buoyancy of the fully loaded floating home.

(b) FREEBOARD

The freeboard, as measured from the waterline to the top of the hull of the completed floating home, including the dead and live load shall be at least fifteen inches (with list angle = O degrees.)

(c) STABILITY WITH OFF-CENTER LOADING; OR WIND LOADING

The floating home, when subjected to either off-center loading or wind loading shall not exceed the limitations on hull immersion and angle of list set forth as follows:

(1) The maximum angle of list shall not exceed four degrees.

(2) The freeboard shall be measured from the waterline to the top of the hull on the side or end of the vessel where said freeboard has its least dimension.

The allowable immersion shall not be more than two-thirds of this freeboard.

The off-center loading shall be considered as applicable to the completed

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floating home, including dead load, and shall consist of a line load of one hundred pounds or five pounds per foot of width, whichever is greater, per lineal foot (1st floor) and fifty pounds or two and one-half pounds per foot of width whichever is greater, per lineal foot (second floor, habitable attic, or loft). The uniform line load is to be applied halfway between the center of gravity and the outside edge of deck, to one side of the floating home at a time. The dividing line is the longitudinal axis of the vessel, and the overturning moment resulting from the off-center loading shall be taken about the computed center of gravity. Stability, with the off-center loading applied, shall be tested on both sides of the longitudinal axis.

Wind loading shall be applied to the completed floating home, including dead load and live load, but not off-center loading. The moment due to the wind loading shall be computed as:

Mw = P x A x H

Where:

Mw = Wind heeling moment, in foot pounds.

P = Wind pressure factor, in pounds per square foot in accordance with the following:

10.0 (for partially protected waters)

A = Area, in square feet, of the projected lateral surface of the vessel above the load waterline. This surface includes the hull, superstructure and areas bounded by railings and/or structural canopies.

H = Height, in feet, to the center of area (a) above the first floor deck.

(Ord. 2440 § 20, 1979: Ord. 1675 § 1 (part), 1968).

19.18.330 **Calculations by engineer.** Calculations by a qualified engineer showing that the stability of the floating home conforms to the above minimum requirements will be acceptable. Said calculations shall be subject to the following provisions:

(a) With reference to Section 19.18.320(a) MG=1.0 feet.

(b) With reference to Section 19.18.320(c)2 calculations shall show that as a result of the list angle caused by the off-center loading, the original freeboard (with list angle = 0.0°) shall not be diminished by more than sixty-seven percent.

(c) With reference to Section 19.18.320(c) calculations shall show that:

$\frac{Mr}{Mo}$ = 1 or more applied with a list = 4.0°

Where.

Mo = overturning moment resulting from the off-center loading, said moment to be taken about a longitudinal line passing through the computed center of gravity of the floating home.

Mr = Resisting moment due to buoyancy, said moment to be taken about a longitudinal line passing through the computed center of gravity.

and:

$\frac{Mr}{Mw}$ = 1 or more applied with a list = 40°

Where:

Mw = wind heeling moment

Mr = resisting moment due to buoyancy (same as Mr above).

(Ord. 1675 § 1 (part), 1968).

19.18.340 Compartmentation and flotation. (a) BULKHEADS. Watertight pontoons, floats, or any other device used to keep the floating home afloat shall be fitted with transverse and/or longitudinal watertight bulkheads which provide compartmentation sufficient to keep the fully loaded vessel afloat with positive stability, with any one main compartment flooded.

For pontoon type flotation, the maximum allowable distance between bulkheads is eight feet zero inches. No single compartment shall comprise more than twenty percent of the total available flotation volume.

(b) HULL TYPE FLOTATION. The hull shall be fitted with at least one longitudinal bulkhead and two transverse bulkheads. No compartment shall comprise more than twenty percent of total available flotation volume. Hull type flotation with less than two transverse bulkheads may be utilized upon demonstration that the structure will remain afloat with one compartment flooded. If construction materials are utilized which make the possibility of rupture of the hull extremely remote, the county may waive this requirement.

(c) FLOTATION DEVICES. The external surfaces of all flotation devices shall be watertight and thoroughly protected from corrosion from saltwater, solvents, and weather. Flotation devices shall be constructed so that access to each compartment is readily available from the first floor level of the completed floating home. Flotation devices shall be structurally sound and securely fastened to the main houseboat structure, as approved by the official.

(d) BILGE PUMP. Where permanent type flotation, such as styrofoam or plastic foam is not provided, a portable bilge pump shall be maintained in proper working order. Bilge pump size and installation shall be approved by the county.

(e) HOLDING TANK. Flotation and decking shall provide access to and protection for the holding tank and sewage pump. (Ord. 1675 § 1 (part), 1968).

19.18.350 Fire prevention. (a) Each floating home or ark shall maintain, on board, at least one ten pound (or equivalent) all-purpose dry

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chemical fire extinguisher for each separate level or floor of habitable living space.

(b) An approved detector for products of combustion shall be installed on floating homes and arks at each sleeping area. (Ord. 2440 § 21, 1979: Ord. 1675 § 1 (part), 1968).

19.18.360 Life saving equipment. Suitable accessible storage shall be provided on deck for the storage of life preservers, ring life buoys or other coast guard approved life saving devices. (Ord. 1675 § 1 (part), 1968).

19.18.370 Occupancy permits. All owners of floating homes moored in Marin County on the effective date of the ordinance codified in this chapter shall apply for an occupancy permit within thirty days of such date, pursuant to Chapter 11.20 of this code. An owner of a floating home mooring in county waters after the effective date of the ordinance codified in this chapter will apply within three days. Following the inspection of a floating home for an occupancy permit, the owner will be advised of any deficiencies that must be corrected and of applicable building permits that may be required. (Ord. 1675 § 1 (part), 1968).

19.18.380 Restrictions. It shall be illegal to inhabit, occupy, moor, lease, rent, or sell any floating home or ark which does not comply with the Marin County Codes.

All arks in existence within the county on the effective date of the ordinance codified in this chapter shall be considered existing nonconforming; provided they meet all requirements of Title 19 and Chapters 11.20 and 11.21 of the Marin County Code. (Ord. 2440 § 22, 1979: Ord. 1675 § 1 (part), 1968).

19.18.400 Temporary berthing permits. The owner/occupant of a floating home which does not comply with the requirements of this chapter, and which floating home was berthed within Richardson Bay in Marin County on September 5, 1979, may apply to the marine inspector for a temporary berthing permit. Those floating homes that were berthed in the unincorporated area of Marin County prior to February 1, 1977, shall be given priority for available berths. A permit may be issued; provided, that the following conditions are met:

(a) Any hazardous condition designated by the marine inspector must be corrected prior to issuance of the permit.

(b) The floating home must comply with Section 19.18.420.

(c) Compliance with the requirements of this chapter will result in inordinate hardship to the owner.

(d) Issuance of the permit will not be detrimental to adjoining uses.

If he grants or denies an application for a temporary berth permit, the marine inspector shall make findings in accordance with the conditions set forth in this section.

Permits may be issued subject to such conditions as the marine inspector deems appropriate, including a bonding requirement.

Any person dissatisfied with a decision of the marine inspector may appeal to the board of supervisors. Appeals must be in writing, accompanied by a fee in the amount of thirty dollars, and filed within ten working days following the decision. (Ord. 2440 § 23, 1979).

19.18.410 Termination date of temporary berthing permits. All temporary berthing permits shall expire:

(a) Upon transfer of ownership, rental or lease, or on January 1, 1985, whichever is later;

(b) Destruction by fire or other causes, which the marine inspector determines is in excess of fifty percent value of the floating home;

(c) Upon notice by the marine inspector that the condition of the floating home constitutes a threat to public health or safety.

Temporary berthing permits shall not be renewed. Upon termination of the temporary berthing permit, the owner/occupant of the floating home shall comply with the provisions of this chapter; provided, that the termination date may be extended if the Marin County board of supervisors find, during a public hearing, that there is adequate justification for an extension. (Ord. 2440 § 24 (part), 1979).

19.18.420 Plumbing. (a) Floating homes or arks which discharge sewage or graywater shall have an injection system installed as specified in Section 19.18.120.

(b) Floating homes or arks which do not discharge sewage or graywater may be excepted from the provisions of Section 19.18.120; provided the following conditions are met:

(1) The floating homes or arks were located within Marin County on September 5, 1979, and did not have a connection to a local sewerage system as of that date.

(2) The floating homes or arks shall not have on-board tubs or showers, or drains which discharge into the bay.

(3) Water closet, tub and/or shower and laundry facilities which are connected to the public sewers are available within an approved structure. The construction and facilities shall conform to the requirements of the Marin County Code, and the structure located within one hundred feet of walking distance from the exempted home or ark.

Alternative methods of waste water disposal, in lieu of the injection and connection system required by this chapter, may be allowed if first approved by the Marin County health department, the State of California Regional Water Quality Control Board, and other applicable local and state agencies. (Ord. 2440 § 24 (part), 1979).

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19.18.510 Penalties for violations. Any person, firm or corporation violating any of the provisions of this chapter shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of the provisions of this chapter is committed, continued, or permitted, and upon conviction of any such violation such person shall be punishable by a fine of not more than five hundred dollars or by imprisonment for not more than six months, or by both such fine and imprisonment. For purpose of uniformity, this section shall be deemed to supersede any of the penalties provided in the respective codes referred to in this chapter. (Ord. 2644 § 2, 1981).

APPENDIX E

CORRESPONDENCE CONCERNING SHELLFISH HARVESTING AND ANTIDEGRADATION POLICY

Febru

FEB 21 1985

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

FEB 21

SUBJECT: Interpretation of the Term "Existing Uses"
Under the Antidegration Policy

FROM: Patrick M. Tobin, Director
Criteria & Standards Division
Pat Tobin

TO: James S. Kutzman, Region IV
Water Quality Standards Coordinator

Under a proper interpretation of the term, an "existing use" can be established by demonstrating that fishing, swimming, or other uses have actually occured since November 28, 1975, or that the water quality is suitable to allow the use to be attained (unless of course there are physical problems, such as substrate or flow, which prevent the use regardless of water quality). In your specific example, shellfish apparently are propagating and surviving in a biologically suitable habitat and are available and suitable for harvesting. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality. To argue otherwise would be to say that the only time an aquatic protection use "exists" is if someone succeeds in catching fish, and that has never been EPA's position.

Section 101(a)(2) of the Clean Water Act calls for that level of water quality which "... provides for the protection and propagation of fish, shellfish,...". To say that the shellfish use exists, and that the water quality must be maintained, only if the shellfish are literally being "harvested" undercuts the objective of the Act to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

cc: Regional WQS Coordinators
Cathy Winer (LE-132W)
Ed Johnson

April 16, 1984

Mr. John Harleston
Staff Counsel
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Dear Mr. Harleston:

Thank you for your letter dated March 29, 1984, to Mr. Charles Jeter, Regional Administrator, EPA Region IV, concerning EPA's requirements for water quality standards and water quality certifications. Because of the need for national consistency in these requirements, Mr. Jeter has referred your inquiry to me in my capacity as national program manager for the water quality standards program.

Your letter states that although your questions have been prompted by the Kiawah Marina hearing, you are not asking for a review of, or comment on, that proceeding. Accordingly, the following discussion does not address that proceeding or the Board's order therein.

Your first question concerns the application of EPA's antidegradation policy. You ask whether the imposition of a sizeable buffer zone, within which shellfish harvesting is prohibited, is consistent with EPA's antidegradation policy when (1) the area to be so designated is currently suitable for and is used for shellfish havesting, (2) the buffer zone is created because of the potential for oyster contamination from polluted water, and (3) the size and location of the buffer zone reflect the area of potential contamination. It is unclear from the information you provided whether, and if so where and to what degree, the actual water quality in the current Kiawah shellfish area will be affected.

EPA's antidegradation policy, now set out at 40 CFR §131.12 (48 FR 51400, November 8, 1983), is very specific, and does not allow the lowering of water quality merely by calling the affected area a buffer zone. The focus of that policy is the protection of water quality necessary to protect existing uses. Where the quality of water exceeds that required for "fishable, swimmable" waters, the state may after following specified procedures and making specified findings allow lower water quality as long as existing uses are fully protected. (Water quality in "outstanding national resource waters" is to be maintained in all cases.) Existing uses are defined as those actually attained in the water body on or after November 28, 1975, whether or not they are included in water quality standards.

EPA's antidegradation policy deliberately speaks of existing uses, not designated uses, and water quality. While water quality standards must contain criteria sufficient to support existing or attainable uses, there may be circumstances where a state may for non-water quality reasons wish to limit, or not designate, a particular use. For example, a state may wish to impose a temporary shellfish ban to prevent overharvesting and ensure an abundant population over the long run. Similarly, a state may wish to restrict swimming from heavily trafficked areas.

Our antidegradation policy is not intended to interfere with such state decisions, as long as criteria supporting existing or attainable uses are adopted and enforced as part of the state's water quality standards. Thus, the notion of a buffer zone is not per se illegal. However, if (and I again stress that I am making no judgment about the Kiawah facts) the buffer zone is based on a recognition that water quality is likely to be lowered to the point that it no longer is sufficient to protect and maintain an existing shellfish harvesting use and the public health, imposition of such a buffer zone is inconsistent with EPA's antidegradation regulation. The fact that the shellfish use may remain in part of the stream, is laudable but immaterial.

Your second question seems to be whether, in issuing a section 401 certification for a marina, a certifying agency should consider possible pollution from any reasonably foreseeable associated activity, such as oil and gas and sewage from vessels using the marina. The short answer is yes. While there are federal requirements applicable to vessels (see sections 311 and 312 of the Clean Water Act), it does not follow that the vessels will never cause or contribute to a violation of water quality standards. First, the certifying agency should consider any available, reliable evidence that indicates that vessels of the type involved generally do or do not meet the requirements of sections 311 and 312. In addition, the certifying agency must consider whether the expected operation of those vessels (whether or not in compliance with sections 311 and 312) is likely to cause or contribute to a violation of water quality standards.

Sincerely,

Original Signed By:

Jack E. Ravan
Assistant Administrator

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
WATER

MAR 25 1985

Mr. John Harleston
Staff Counsel
South Carolina Department of
Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Dear Mr. Harleston:

Thank you for your letter of March 8, 1985, requesting guidance on the interpretation and application of the antidegredation policy. I am pleased you found useful my reply to your earlier letter. I have answered your questions in the order you presented.

The relevant facts as contained in your letter are that an applicant for 401 certification wishes to construct a marina in open shellfish waters, now classified by the State for shellfish harvesting, where such shellfish are found and are suitable for human consumption. A lease has been granted for harvesting and if the marina is constructed the site will be closed by the State for harvesting because of possible shellfish contamination.

Question 1:

Assuming that there has been no actual harvesting, would the prevention of potential harvesting by the permitting of an activity that may affect water quality, in an area that is now of suitable water quality, violate the antidegradation policy?

Answer:

Yes. Under a proper interpretation of the term, an "existing use" can be established by demonstrating that fishing, swimming, or other uses have actually occurred since November 28, 1975, or that the water quality is suitable to allow the use to be attained (unless of course there are physical problems, such as substrate or flow, which prevent the use regardless of water quality). In your specific example, shellfish apparently are propagating and surviving in a biologically suitable habitat and are available and suitable for harvesting. Such facts clearly establish that shellfish harvesting is an "existing" use, not one dependent on improvements in water quality. To argue otherwise would be to suggest that the only time an aquatic protection use "exists" is if someone succeeds in catching fish, and that has never been EPA's position.

Section 101(a)(2) of the Clean Water Act calls for that level of water quality which "...provides for the protection and propagation of fish, shellfish,...". To say that the shellfish use exists, and that the water quality must be maintained, only if the shellfish are literally being "harvested" undercuts the objective of the Act to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

Question 2:

Assuming there has been no actual harvesting, does the designation of the area by the State for shellfish harvesting, both by SA classification, and by a shellfish lease which requires cultivation as a lease condition, create an "existing use" without proof of actual harvesting in the affected area?

Answer:

See Answer to Question 1, above. Please note that it is not the "designation" of a use that creates an "existing" use, since a designated use may be one that has not yet been attained, under 40 CFR §131.3(f). A "designated" use that is not an existing use may in some circumstances be downgraded to another use under §131.10(g) of the water quality standards regulation; an "existing" use, however, must be maintained and protected whether or not it is also a "designated" use. In addition, whether a lease has or has not been granted is technically irrelevant to the determination of an "existing" use, although normally one would not expect a lease to be issued unless there were a potential for shellfishing.

Question 3:

Assuming that water quality has been suitable for harvesting, but that actual harvesting has been documented only after the time of the application for certification (and other permits), is there an existing use for harvesting, i.e., should the certifying agency disregard facts occurring after the time application?

Answer:

The certifying agency may consider these facts as additional evidence that a use exists but, as indicated in my response to Question 1, actual harvesting is not necessary to determine an existing use.

Question 4:

Assuming that actual harvesting has taken place in the marina vicinity, but by persons other than the shellfish leaseholder, and without the leaseholder's permission, i.e., the harvesting was illegal because of the exclusive lease, is there an existing use for harvesting, i.e., does existing use encompass illegal uses?

Answer:

As indicated above, a determination that shellfish harvesting is an "existing use" is not dependent on evidence of actual harvesting. Therefore, it follows that it is irrelevant, for purposes of the antidegradation policy, whether any harvesting which did occur complied with the applicable lease.

I trust these answers will be helpful to the Department of Health and Environmental Control. As you may be aware I will soon be assuming the duties of Regional Administrator in Atlanta. I look forward to working with you on this and other related issues.

Sincerely,

Jack E. Ravan

Jack E. Ravan
Assistant Administrator
for Water

cc: Jim Kutzman (Region IV)
Cathy Winer (OGC)

APPENDIX F

PRINCIPAL FEDERAL AND STATE PERMITTING, CERTIFICATION AND REVIEW AGENCIES

PRINCIPAL STATE AND FEDERAL PERMITTING, CERTIFICATION AND REVIEW AGENCIES

NORTH CAROLINA	RESOURCE CATEGORIES (Table 6-1)
Permitting/Certification Agencies	
Department of the Army Corps of Engineers Wilmington District P.O. Box 1890 Wilmington, NC 28402 Attn: Cliff Winefordner (919) 343-4631	All Resources
Department of Natural Resources and Community Development Division of Environmental Management Water Quality Section Attn: Forrest Westall (919) 733-5083	Water Quality Groundwater
Department of Natural Resources and Community Development Office of Coastal Management* P.O. Box 27687 Raleigh, NC 27611-7687 Attn: John R. Parker, Jr. (919) 733-2293	Groundwater Aquatic Habitat Terrestrial Habitat Wetland Aesthetic

*Regional Field Offices of the Office of Coastal Management:

West of the Chowan River and south of Pamlico River including southern half of Beaufort County

Coastal Management Field Services
1502 N. Market Street
Washington, NC 27889
Attn: David Gossett
(919) 946-6481

East of Chowan River and north of Albemarle Sound to VA border, including northern Dare County and outer banks of Ocracoke Inlet

Coastal Management Field Services
108 S. Water Street
Elizabeth City, NC 27909
Attn: Nelson Paul
(919) 338-0206

NORTH CAROLINA (continued)	RESOURCE CATEGORIES (Table 6-1)
South of New River Inlet to South Carolina border	
Coastal Management Field Services 725 Wrightsville Avenue Wilmington, NC 28403 Attn: Rob Moul or Bob Stroud (919) 256-4161	
South of Pamlico River and Beaufort County to New River including barrier islands from Ocracoke Inlet to north of New River Inlet	
Coastal Management Field Services P.O. Box 769 Morehead City, NC 28557 Attn: Preston Pate et al. (919) 733-2160 or 726-7021	
Review Agencies	
U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Avenue Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland
U.S. Department of Commerce National Marine Fisheries Service Beaufort, NC 28516 Attn: Randall Cheek (919) 728-5090	Aquatic Habitat Wetland
U.S. Department of the Interior Fish and Wildlife Service Division of Ecological Services 310 New Bern Avenue, Room 468 Raleigh, NC 27601-1470 Attn: Field Supervisor (919) 755-4520	Aquatic Habitat Wetland Terrestrial Habitat
U.S. Coast Guard Cdr. 5th Coast Guard District (m) 431 Crawford Parkway Federal Building Portsmouth, VA 23705 Attn: Chief of Marine Safety (804) 398-6372	Navigation

NORTH CAROLINA (continued)	RESOURCE CATEGORIES (Table 6-1)
Department of Human Resources Division of Health Services Shellfish Sanitation Office P.O. Box 769 Morehead City, NC 28557 Attn: Bob Benton, Supervisor (919) 726-6827	Shellfish
State Historic Preservation Office 109 East Jones Street Raleigh, NC 27611 Attn: Dr. William Price, Jr. (919) 726-7021	Historical Archaeological

SOUTH CAROLINA

Permitting/Certification Agencies

Department of the Army Corps of Engineers, Charleston District P.O. Box 919 Charleston, SC 29402 Attn: Robert Riggs (803) 724-4330	All Resources
Coastal Council Office of Coastal Planning Summerall Center, Suite 802 19 Hagood Avenue Charleston, SC 29402 Attn: Permit Administrator (803) 792-5808	Aquatic Habitat Terrestrial Habitat Wetland Socioeconomic
Department of Health and Env. Control Office of Env. Quality Control 2600 Bull Street Columbia, SC 29202 Attn: Chester Sansbury (803) 758-5496	Water Quality Groundwater

Review Agencies

U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Avenue Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland

SOUTH CAROLINA (continued)	RESOURCE CATEGORIES (Table 6-1)
U.S. Department of Commerce National Marine Fisheries Service Beaufort, NC 28516 Attn: Randall Cheek (919) 728-5090	Aquatic Habitat Wetland
South Carolina Wildlife and Marine Resources Department P.O. Box 167 1000 Assembly Street Columbia, SC 29202 Attn: Ed Duncan (803) 758-0020	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Department of the Interior Fish and Wildlife Service Division of Ecological Services P.O. Box 12559 Charleston, SC 29412 Attn: Field Supervisor (803) 724-4707	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Coast Guard Cdr. 7th Coast Guard District (m) 51 SW 1st Avenue Miami, FL 33130 Attn: Chief of Marine Safety (305) 350-5651	Navigation
South Carolina Archives Department 1430 Senate Street Columbia, SC 29211 Attn: Charles Lee, Director (803) 758-5816	Historical Archaeological
Department of Health and Env. Control Shellfish and Recreational Waters Division Bureau of Special Environmental Programs 2600 Bull Street Columbia, SC 29201 Attn: J. Luke Hause, Director (803) 758-4963	Shellfish

GEORGIA

Permitting/Certification Agencies	RESOURCE CATEGORIES (Table 6-1)
District Engineer Department of the Army Corps of Engineers, Savannah District P.O. Box 889 Savannah, GA 31402 Attn: Mr. Stephen Osvald (912) 944-5347	All Resources
Department of Natural Resources Environmental Protection Division 270 Washington Street, SW Atlanta, GA 30334 Attn: Mike Creason (404) 656-4887	Water Quality Groundwater
Department of Natural Resources Coastal Protection Division Marsh and Beach Section 1200 Glynn Avenue Brunswick, GA 31523 Attn: Dr. Frederick Marland (912) 264-7365	Aquatic Habitat Wetland
Department of Natural Resources 270 Washington Street, SW Atlanta, GA 30334 Attn: James B. Talley (404) 656-3508	Socioeconomic
Review Agencies	
U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Avenue Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland
U.S. Department of Commerce National Marine Fisheries Service Beaufort, NC 28516 Attn: Randall Cheek (919) 728-5090	Aquatic Habitat Wetland

GEORGIA (continued)

	RESOURCE CATEGORIES (Table G-1)
Department of the Interior Fish and Wildlife Service Division of Ecological Services 801 Gloucester Street Brunswick, GA 31520 Attn: Field Supervisor (912) 265-9336	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Coast Guard Cdr. 7th Coast Guard District (m) 51 SW 1st Avenue Miami, FL 33130 Attn: Chief of Marine Safety (305) 350-5651	Navigation
Department of Natural Resources Historic Preservation Section 270 Washington Street, SW, Rm. 704 Atlanta, GA 30334 Attn: Dr. Elizabeth A. Lyon (404) 656-2840	Historical Archaeological
Department of Natural Resources Coastal Resources Division 1200 Glynn Avenue Brunswick, GA 31520 Attn: Charles F. Cowman, Jr. (912) 264-7218	Shellfish

FLORIDA

Permitting/Certification Agencies

Department of the Army Corps of Engineers Jacksonville District P.O. Box 4970 Jacksonville, FL 32232 Attn: Jim Boone (904) 792-1666	All Resources
Department of Environmental Regulation Twin Towers Office Bldg. Tallahassee, FL 32301-8241 Attn: Jeremy Craft (904) 488-0130	Water Quality Groundwater Aquatic Habitat Wetland

FLORIDA (continued)	RESOURCE CATEGORIES (Table 6-1)
Department of Natural Resources Marjory Stoneman Douglas Building Tallahassee, FL 32303 Attn: Jim McFarland (Division of State Lands) (904) 488-2725 Debbie Flack (Division of Beaches and Shores) (904) 488-3180	Socioeconomic
U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Street Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland
U.S. Department of Commerce National Marine Fisheries Service 3500 Delwood Beach Road Panama City, FL 32407 Attn: Ed Keppner (904) 234-5061	Aquatic Habitat Wetland
U.S. Department of the Interior Fish and Wildlife Service Division of Ecological Services P.O. Box 2676 Vero Beach, FL 32960* Attn: Field Supervisor (305) 562-3903	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Coast Guard Cdr. 7th Coast Guard District (m) Miami, FL 33130 Attn: Chief of Marine Safety (305) 350-5651	Navigation

*If project location is north of
St. Johns River, USFWS contact is:
801 Gloucester Street
Brunswick, GA 31520
Attn: Field Supervisor
(912) 265-9336

If project location is in western
coastal area, north of Suwanee
River, USFWS contact is:
1612 June Avenue
Panama City, FL 32405
Attn: Field Supervisor
(904) 769-0552

FLORIDA (continued)

	RESOURCE CATEGORIES (Table 6-1)
Division of Archives, History and Records Mgmt. Department of State Tallahassee, FL 32301 Attn: George W. Percey (904) 487-2333	Historical Archaeological
Department of Natural Resources 3900 Commonwealth Blvd. Tallahassee, FL 32303 Attn: John Schneider (904) 488-5471	Shellfish

ALABAMA

Permitting/Certification Agencies

Department of the Army Corps of Engineers, Mobile District Regulatory Functions Branch P.O. Box 2288 Mobile, AL 36628 Attn: Davis L. Findley (205) 694-3771	All Resources
Department of Environmental Management Permit Coordination Center 1751 Federal Drive Montgomery, AL 36130 Attn: Marilyn Elliott (205) 271-7700	Water Quality Groundwater Aquatic Habitat Wetland

Review Agencies

U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Street Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland
U.S. Department of Commerce National Marine Fisheries Service 3500 Delwood Beach Road Panama City, FL 32407 Attn: Ed Keppner (904) 234-5061	Aquatic Habitat Wetland

ALABAMA (continued)

	RESOURCE CATEGORIES (Table 6-1)
U.S. Department of the Interior Fish and Wildlife Service Division of Ecological Services P. O. Drawer 1197 Daphne, AL 36526 Attn: Field Supervisor (205) 690-2181	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Coast Guard Cdr. 8th Coast Guard District (m) Room 1341 Hale Boggs Federal Building 500 Camp Street New Orleans, LA 70130 Attn: Chief of Marine Safety (504) 587-6271	Navigation
Alabama Department of Conservation and Natural Resources 64 North Union Street Montgomery, AL 36130 Attn: Bob McCrory (205) 261-3484	Aquatic Habitat Shellfish
Alabama Historic Commission 725 Monroe Street Montgomery, AL 36130 Attn: Mr. F. Lawrance Oaks (205) 261-3184	Historical Archaeological
Department of Environmental Management 4358 Midmost Drive Mobile, AL 36609 Attn: Brad Gane (205) 479-2336	Water Quality Aquatic Habitat Wetland

MISSISSIPPI

Permitting/Certification Agencies

Department of the Army Corps of Engineers Mobile District* Regulatory Functions Branch P.O. Box 2288 Mobile, AL 36628 Attn: Davis L. Findley (205) 694-3771	All Resources

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*Vicksburg District, if project is in the Pearl River drainage basin

MISSISSIPPI (continued)	RESOURCE CATEGORIES (Table 6-1)
Department of Natural Resources Bureau of Pollution Control Jackson, MS 39209 Attn: Robert Seyfarth (601) 961-4790	Water Quality Groundwater
Department of Wildlife Conservation Bureau of Marine Resources P.O. Drawer 959 Long Beach, MS 39560 Attn: Bureau Director (601) 864-4602	Aquatic Habitat Terrestrial Habitat Wetland Socioeconomic
Secretary of State Jackson, MS Attn: Ed Pittman (601) 961-4790	Socioeconomic
Review Agencies	
U.S. Environmental Protection Agency Ecological Review Branch Region IV 345 Courtland Avenue Atlanta, GA 30308 Attn: Reginald Rogers (404) 881-7901	Water Quality Groundwater Wetland
U.S. Department of Commerce National Marine Fisheries Service 3500 Delwood Beach Road Panama City, FL 32407 Attn: Ed Keppner (904) 234-5061	Aquatic Habitat Wetland
U.S. Department of the Interior Fish and Wildlife Service Division of Ecological Services P.O. Drawer 1197 Daphne, AL 36526 Attn: Field Supervisor (205) 690-2181	Aquatic Habitat Terrestrial Habitat Wetland
U.S. Coast Guard Cdr. 8th Coast Guard District (m) Room 1341 Hale Boggs Federal Building 500 Camp Street New Orleans, LA 70130 Attn: Chief of Marine Safety (504) 587-6271	Navigation

MISSISSIPPI (continued)	RESOURCE CATEGORIES (Table 6-1)
Department of Archives and History P.O. Box 571 Jackson, MS 39205 Attn: Elbert Hilliard, Director (601) 359-1424	Historical Archaeological
Department of Health Shellfish Sanitation Office P.O. Box 328 Gulfport, MS 39501 Attn: Anthony Taconi (601) 863-1036	Shellfish
Department of Wildlife Conservation Bureau of Marine Resources Wetlands Division P.O. Drawer 959 Longbeach, MS 39560 Attn: Joe Gill (601) 864-4602	Shellfish

APPENDIX G

EXAMPLES OF PERMIT APPLICATION MATERIALS

Note: Permitting materials for individual states reported here may change. Refer to respective agencies for current information.

NORTH CAROLINA

APPLICATION
FOR

PERMIT TO EXCAVATE AND/OR FILL **WATER QUALITY CERTIFICATION**

EASEMENT IN LANDS COVERED BY WATER **CAMA PERMIT FOR MAJOR DEVELOPMENT**

Department of Administration
(GS 146-12)

State of North Carolina
Department of Natural Resources and Community Development
(GS 113-229, 143-215.3(a)(1), 143-215.3(c), 113A-118

Department of the Army
Corps of Engineers, Wilmington District
(33 CFR 209.320-329)

Please type or print and fill in all blanks. If information is not applicable, so indicate by placing N/A in blank.

I. Applicant Information

A. Name ______________________________
Last First Middle

B. Address ______________________________
Street, P. O. Box or Route

____
City or Town State Zip Code Phone

II. Location of Proposed Project:

A. County ______________

B. 1. City, town, community or landmark ______________________________

2. Is proposed work within city limits? Yes _____ No _____

C. Creek, river, sound or bay upon which project is located or nearest named body of water to project ______________________________

III. Description of Project

A. 1. Maintenance of existing project ______________ 2. New work ______________

B. Purpose of excavation or fill

1. Access channel ______________ length ________ width ________ depth ________
2. Boat basin ______________ length ________ width ________ depth ________
3. Fill area ______________ length ________ width ________ depth ________
4. Other ______________ length ________ width ________ depth ________

C. 1. Bulkhead length ________ Average distance waterward of MHW (shoreline) ________

2. Type of bulkhead construction (material) ______________________________

D. Excavated material (total for project)

1. Cubic yards ______________ 2. Type of material ______________

E. Fill material to be placed below MHW (see also VI. A)

1. Cubic yards ______________ 2. Type of material ______________

IV. Land Type, Disposal Area, and Construction Equipment:

A. Does the area to be excavated include any marshland, swamps or other wetland? Yes _____ No _____

B. Does the disposal area include any marshland, swamps or other wetland? Yes _____ No _____

C. Disposal Area

1. Location ______________________________
2. Do you claim title to disposal area? ______________________________

D. Fill material source if fill is to be trucked in ______________________________

E. How will excavated material be entrapped and erosion controlled? ______________________________

F. Type of equipment to be used ______________________________

G. Will marshland be crossed in transporting equipment to project site? If yes, explain ______________________________

D&F-B1
Rev. 10/78

V. Intended Use of Project Area (Describe)

A. 1. Private
2. Commercial
3. Housing Development or Industrial
4. Other

B. 1. Lot size(s)
2. Elevation of lot(s) above mean high water
3. Soil type and texture
4. Type of building facilities or structures
5. Sewage disposal and/or waste water treatment A. Existing ____ Planned ____
B. Describe
6. Land Classification (circle one) DEVELOPED TRANSITIONAL COMMUNITY RURAL CONSERVATION OTHER ____ (See CAMA Local Land Use Plan Synopsis)

VI. Pertaining to Fill and Water Quality:

A. Does the proposed project involve the placement of fill materials below mean high water? Yes____ No____

B. 1. Will any runoff or discharge enter adjacent waters as a result of project activity or planned use of the area following project completion? Yes____ No____
2. Type of discharge
3. Location of discharge

VII. Present rate of shoreline erosion (if known):

VIII. List permit numbers and issue dates of previous Department of Army Corps of Engineers or State permits for work in project area, if applicable:

IX. Length of time required to complete project:

X. In addition to the completed application form, the following items must be provided:

A. Attach a copy of the deed (with State application only) or other instrument under which applicant claims title to the affected property. OR if applicant is not claiming to be the owner of said property, then forward a copy of the deed or other instrument under which the owner claims title plus written permission from the owner to carry out the project on his land.

B. Attach an accurate work plat drawn to scale on 8½ X 11" white paper (see instruction booklet for details). Note: Original drawings preferred - only high quality copies accepted.

C. A copy of the application and plat must be served upon adjacent riparian landowners by registered or certified mail or by publication (G.S. 113-229 (d)) Enter date served

D. List names and complete addresses of the riparian landowners with property adjoining applicant's. Such owners have 30 days in which to submit comments to agencies listed below.

XI. Certification requirement: I certify that to the best of my knowledge, the proposed activity complies with the State of North Carolina's approved coastal management program and will be conducted in a manner consistent with such program.

XII. Any permit issued pursuant to this application will allow only the development described in this application and plat. Applicants should therefore describe in the application and plat all anticipated development activities, including construction, excavation, filling, and land clearing.

DATE ____

Applicant's Signature

SEE REVERSE SIDE FOR MAILING INSTRUCTIONS

PLEASE BE SURE THAT:

- Both copies are completed
- All blanks are filled in
- You have signed both copies

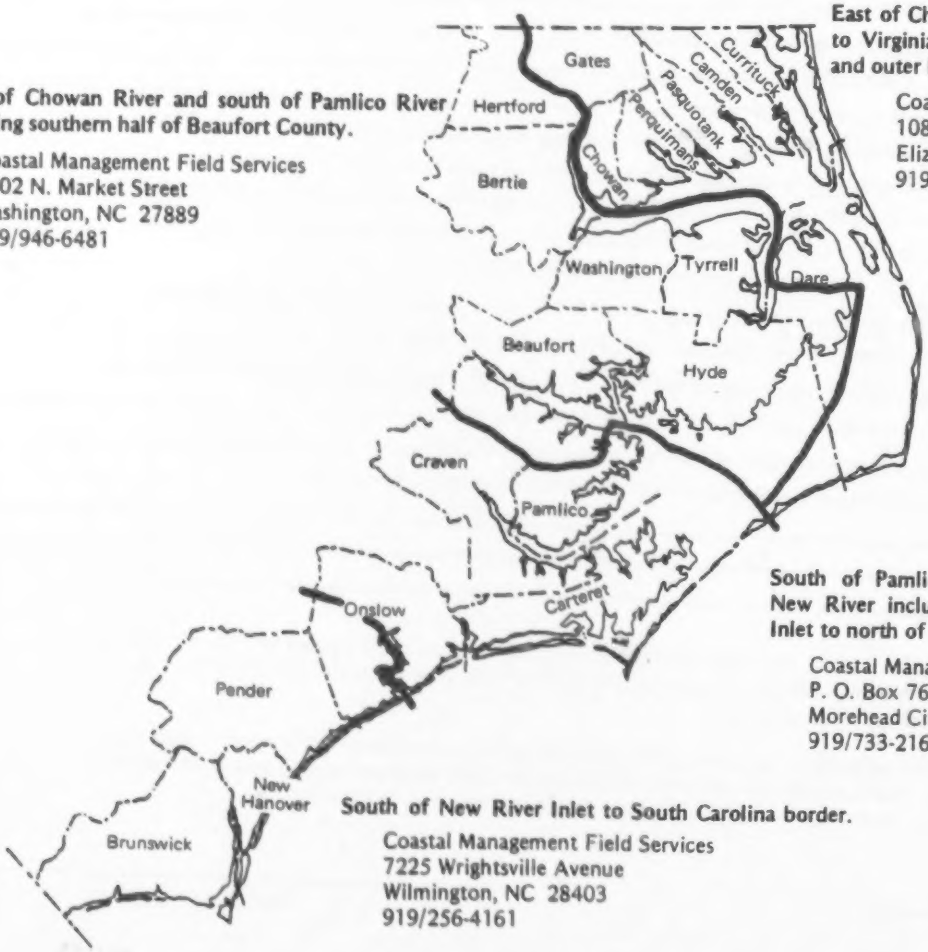
If you have any questions please call your regional field office.

Mail one copy to:

District Engineer
Wilmington District Corps of Engineers
P. O. Box 1890
Wilmington, N. C. 28402
(Note: attach Corps transmittal letter)
Phone: 919/343-4631

AND

Mail one copy to your regional field office as indicated on the map below:


Gates
Currituck
Camden
Hertford
Pasquotank
Perquimans
Chowan
Bertie
Washington
Tyrrell
Dare
Beaufort
Hyde
Craven
Pamlico
Onslow
Carteret
Pender
New Hanover
Brunswick

East of Chowan River and north of Albemarle Soun to Virginia border, including northern Dare Coun and outer banks to Ocracoke Inlet.

Coastal Management Field Services
108 S. Water Street
Elizabeth City, NC 27909
919/338-0206

West of Chowan River and south of Pamlico River including southern half of Beaufort County.

Coastal Management Field Services
1502 N. Market Street
Washington, NC 27889
919/946-6481

South of Pamlico River and Beaufort County to New River including barrier islands from Ocracoke Inlet to north of New River Inlet.

Coastal Management Field Services
P. O. Box 769
Morehead City, NC 28557
919/733-2160 or 726-7021

South of New River Inlet to South Carolina border.

Coastal Management Field Services
7225 Wrightsville Avenue
Wilmington, NC 28403
919/256-4161

SOUTH CAROLINA

SOUTH CAROLINA COASTAL COUNCIL
Summerall Center
19 Hagood Street, Suite 802
Charleston, South Carolina 29403
(803) 792-5808

INTRODUCTION

The South Carolina Coastal Management Act (Act 123) was enacted by the General Assembly of South Carolina to provide for the protection and enhancement of the State's coastal resources.

This Act creates the South Carolina Coastal Council, which is given the task of promoting the economic and social welfare of the citizens of this state while protecting the sensitive and fragile areas of the coast. Within a framework of a coastal planning program, the Council will encourage the protection and sound development of coastal resources.

An important part of this program is a coastal permitting system. As mandated in this Act, the Council has direct state authority to deny or issue permits in the critical areas designated in this Act.

PUBLIC NOTICE

NOTICE OF ADMINISTRATIVE FEE SCHEDULE FOR PERMIT APPLICATIONS

Pursuant to Act 466 of the 1982 South Carolina Legislature, the South Carolina Coastal Council is hereby establishing the following ADMINISTRATIVE FEE SCHEDULE for all applications received by the Coastal Council on or after July 1, 1982.

Private, single-family residential, non-commercial activity	$ 50.00
Commercial activity	$200.00
Industrial and special commercial	$500.00
Marinas	$500.00
Local and Federal agencies	$ 50.00
General Permits	$200.00

No application will be processed until payment of the appropriate fee is received. This fee is a non-refundable administrative fee that has no bearing whatsoever on the outcome of the application.

This fee schedule is subject to change by the South Carolina Coastal Council. All checks are to be made payable to South Carolina Coastal Council.

Instructions for Application

1. To be filled in by staff
2. Mailing address
3. Mailing address
4. (A) Dock, boat ramp, etc. (B) Private use; joint landowner use; etc. (C) Briefly describe dimensions (length, width, depth, etc.) and materials to be used.
5. Self explanatory
6. If activity is to take place on a major wetland (i.e. Edisto River), name that wetland. If not, describe as follows - Factory Creek off the Beaufort River. Latitude and longitude may be obtained from U. S. Geologic Survey maps.
7. If not sure, estimate as closely as possible.

NOTE: Read through checklist before completing drawings.

SOUTH CAROLINA COASTAL COUNCIL

(Regular Application)

Date ____________________

1. Application number (to be assigned by the Council)

____

2. Name and address of applicant:

Telephone (during Business hours) ____________________

3. Name, address and title of authorized agent:

Telephone (during business hours) ____________________

4. Describe the dimensions and specifications of the proposed activity, its purpose and intended use:

5. Names and addresses of adjoining property owners:

6. Location of proposed activity: Street, road or other descriptive location ____________________

____

County ____________ Nearest town ____________

Waterway or wetland ____________________

Latitude and longitude (if known) ____________________

7. Date construction to commence ____________________

Date construction to be completed ____________________

8. Additional remarks:

9. I certify that the information contained in this application is true, complete and accurate to the best of my knowledge and belief.

____

Signature of Applicant

____

Date

PROOF OF OWNERSHIP MUST BE SUBMITTED WITH YOUR APPLICATION.

Please submit the Affidavit Of Ownership or Control" on page 10. A copy of the deed, a lease, or other instrument of record may be included in addition to the affadavit, if desired. The affadavit must be signed. The following information must be included:

1. The "Affidavit Of Ownership or Control" should be signed by at least one owner of the property, lessee, or easement holder.
2. Under the section "Description", describe the location and boundaries of the property with as much precision as possible.

    --If subdivided, the property should be described by lot number, block number (if any), name of subdivision, and plat book number and page, where recorded.

    --If unplatted, the property should be described by section, township and range, and subdivision of section.

    --If the description is based on courses and distances not following the plan coordinates, the point of beginning should be identified.
3. Make sure the affidavit is signed and notarized.

FILL THIS OUT AND RETURN IT WITH YOUR
PERMIT APPLICATION. SEE PAGE 9.

AFFIDAVIT OF OWNERSHIP OR CONTROL

TO THE SOUTH CAROLINA COASTAL COUNCIL

I hereby certify that I am the (check one):

record owner ____________
lessee ____________
record easement holder ____________
applicant to record owner for easement ____________

of the below described property situated in ______________________ County, South Carolina; and that said property is all of the property that is contiguous to and landward of the area in which the work proposed in the permit application is to be conducted. Furthermore, I certify that as record owner, lessee, or record easement holder I have, or will have prior to undertaking the work, necessary approvals or permission from all other persons with a legal interest in said property to conduct the work proposed in the permit application.

DESCRIPTION

____
Signature of Applicant

Sworn to and subscribed before me at ______________________

______________________County, ______________________, this ____________

day of ________________, 19 ____.

____
Notary Public

My commission expires:

SOUTH CAROLINA COASTAL COUNCIL

Guidelines

1. The structure owner must make every reasonable effort to perform the work authorized herein in a manner so as to minimize any adverse impacts of the work on fish, wildlife and natural environmental values.

2. The applicant must perform the work authorized herein in a manner so as to minimize any degradation of water quality.

3. The applicant shall permit the South Carolina Coastal Council, the District Engineer, the State Law Enforcement Division, the South Carolina Wildlife and Marine Resources Department, and other State Permit inspection agencies, their representative(s) or designee(s) to make periodic inspection at any time deemed necessary in order to assure that the activity being performed is in accordance with the terms and conditions prescribed herein.

4. The applicant shall maintain the structure in good condition.

5. No attempt shall be made by the applicant to prevent reasonable used by the public of all navigable waters adjacent to the structure.

6. If the display of lights and signals on any structure authorized herein is not otherwise provided by law, such lights and signals as may be prescribed by the United States Coast Guard shall be installed and maintained by and at the expense of the structure owner.

7. If and when a structure owner desires to abandon a structure, unless such abandonment is part of a transfer procedure by which the individual is transferring ownership of the structure, he may be required to remove the structure.

8. There shall be no unreasonable interference with navigation by the existence or use of structures authorized herein.

9. Applicants are advised of the possibility of damage by natural forces or wave wash from passing vessels. The issuance of a permit does not relieve the applicant from taking all proper steps to insure the integrity of their structures permitted hereby and the safety of boats moored thereto from damage by wave wash, and the applicant shall not hold the South Carolina Coastal Council, the State of South Carolina, or the United States liable for any such damage.

10. An applicant, upon receipt of a notice from the South Carolina Coastal Council of failure to comply with the terms, conditions, or standards of the permit, shall, within sixty (60) days without expense to the South Carolina Coastal Council and in such a manner as the afordsaid agency or their authorized representative(s) may direct, effect compliance with terms, conditions, and standards or remove his structure from South Carolina wetlands.

11. A plan or drawing showing the applicant's proposal and the manner or method by which the proposal shall be accomplished will be required with the application. The requirements for the drawings are contained herein.

12. A plat or copy of a plat of the area in which the proposed work will take place will be required with the application.

13. Also, required with the application will be a certified copy of the deed, lease, or other instrument under which the applicant claims title, possession or permission from the owner of the property to carry out the proposal.

14. The applicant shall furnish proof of publication of a notice of planned activity in a newspaper of local circulation and statewide circulation. The notice shall be published within fifteen (15) days of the date of permit application. Additionally, the applicant must furnish the Council with a certified copy of the newspaper notice before the permit will be issued.

DRAWING REQUIREMENTS

1. General

   a. Submit one original copy of all drawings on 8½ x 11 inch paper. Submit the fewest number of sheets necessary to adequately show the proposed activity. Drawings should be in accordance with the general format of the enclosed sample drawings and must be neat, accurate, and concise.

   b. Drawings should not show the identity of engineers, architects or consultants employed to prepare plans for the proposed activity.

   c. A one inch margin should be left at the top edge of each sheet for binding purposes.

   d. Since drawings must be reproduced photographically, color shading cannot be used. Drawings may show work as dot shading, hatching, cross-hatching or similar graphic symbols.

   e. Show distance across channel or to navigation channel where applicable.

   f. Identify methods of construction and types of equipment to be used.

2. Location Map (Must be sufficient for field personnel to locate site- include written directions if necessary)

   a. Show location of activity and name of waterway.

   b. Show name and distance to local town, community or other identifying location.

   c. Identify map or chart from which vicinity map was taken, if applicable.

   d. Show longitude and latitude, if known.

   e. Show north arrow.

3. Plan View

   a. Show shoreline with the proposed activity and any adjacent existing structures.

   b. Show direction of river flow/ebb and flow of tide, if applicable.

   c. Show high and low water lines.

   d. Show dimensions of structures and distance from nearest property line.

e. Identify materials used in construction. If dredging or filling is involved, show volume and type of materials to be moved and grade to be used.

f. Show adjacent property owners. On narrow waterways the property owner on the opposite shore must also be identified.

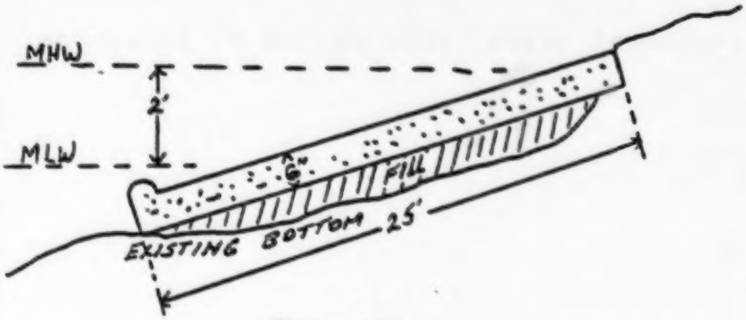
g. For elevation and/or sectional views, show height of structure above mean high water.

h. Show graphic scale.

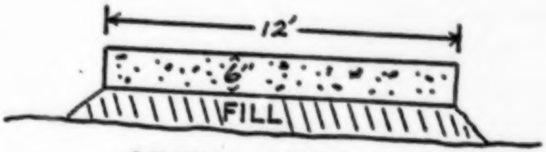
i. Show north arrow.

PLAN

Side View


MHW
MLW
2'
6"
FILL
EXISTING BOTTOM
25'

Top View



CROSS-SECTION

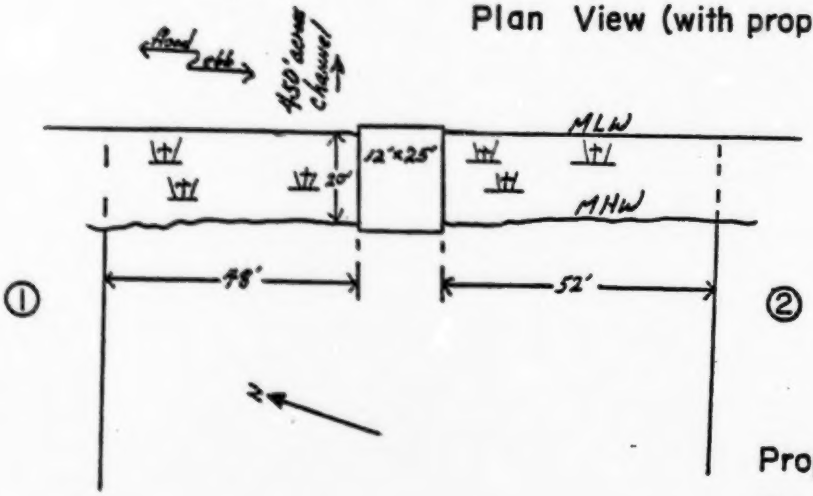
Location Map

N

Use full page for location map if needed to adequately locate site.

Reference:

Plan View (with property lines)


Road
20ft
450' across channel
MLW
12'×25'
20'
MHW
48'
52'
①
②
N

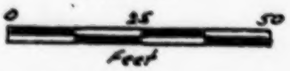
Proposed activity: *Boat Ramp*

County: *Beaufort*

Applicant: *William Penn*

(show all dimensions)

SCALE



PROPOSED:

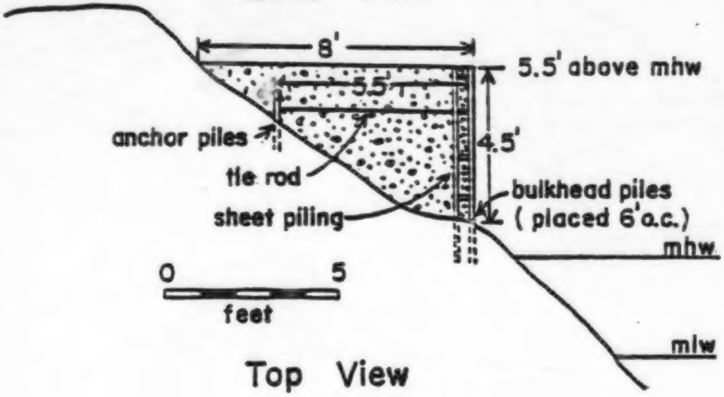
NAME & ADDRESS OF ADJACENT PROPERTY OWNERS

① *John Doe 42 Bay Dr., Beaufort*

② *Betty Winkler 44 Bay Dr., Beaufort*

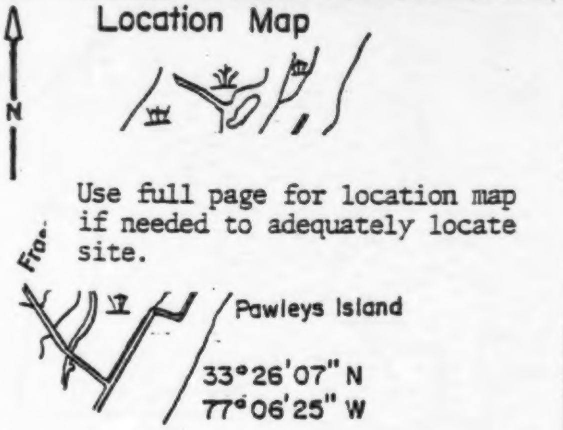
PLAN

Side View


8'
5.5'
5.5' above mhw
4.5'
anchor piles
tie rod
sheet piling
bulkhead piles
(placed 6' o.c.)
mhw
mlw
0
5
feet

Top View

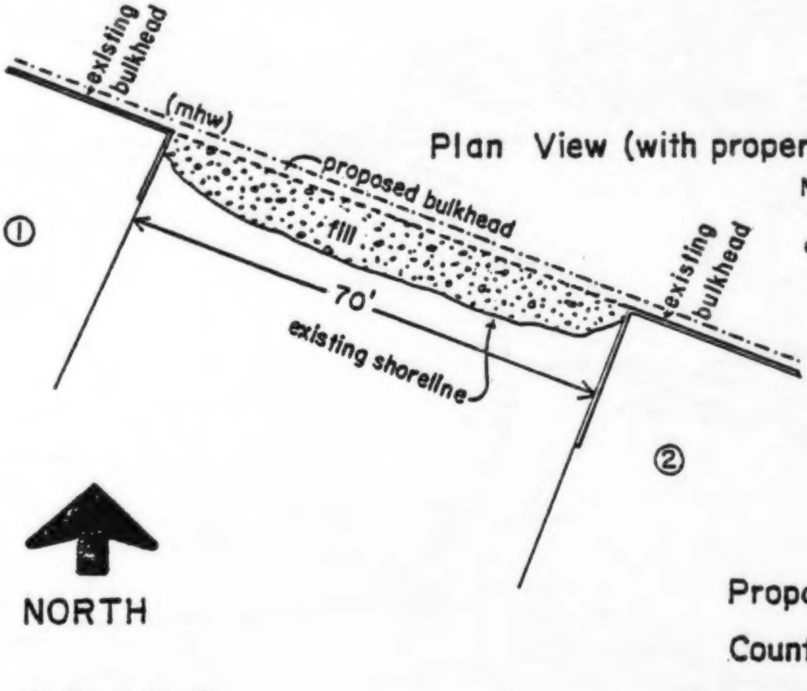
Location Map


N
Fra
Pawleys Island
33°26'07" N
77°06'25" W

Use full page for location map if needed to adequately locate site.

Reference: USGS quad-Magnolia Beach

Plan View (with property lines)


existing bulkhead
(mhw)
proposed bulkhead
fill
70'
existing shoreline
existing bulkhead
①
②

NOTE!
Indicate type and volumn of fill

NORTH

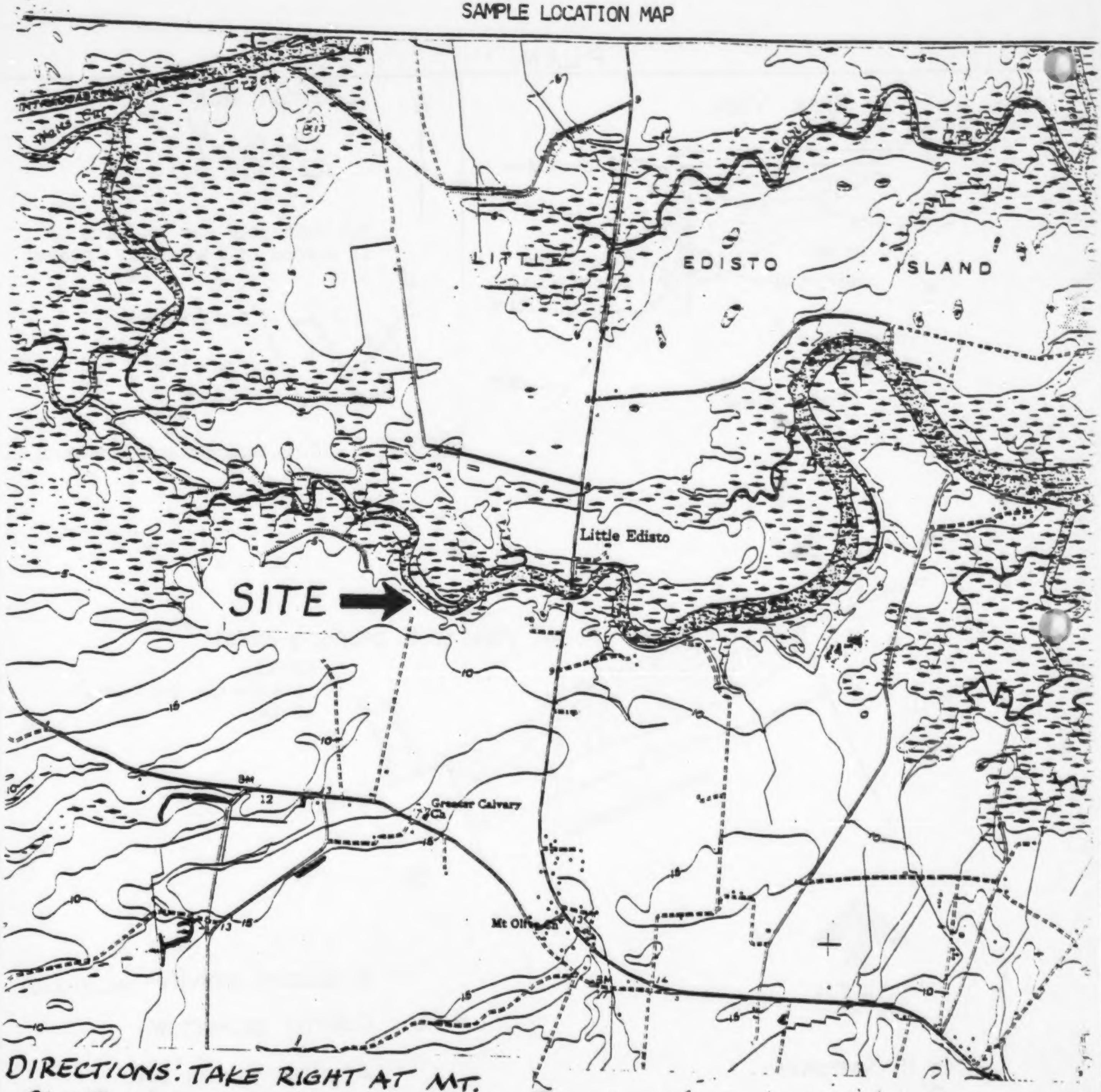
(show all dimensions)
SCALE
0 50
FEET

Proposed activity: BULKHEAD
County: GEORGETOWN
Applicant: JOHN DOE

PROPOSED:

NAME & ADDRESS OF ADJACENT PROPERTY OWNERS
①
②

SAMPLE LOCATION MAP


INTRACOASTAL WATERWAY
Watts Cut
Creek
Sand Creek
LITTLE EDISTO ISLAND
Little Edisto
SITE
Greater Calvary Ch
Mt Olive Ch
12
174
BM
5
10
15

DIRECTIONS: TAKE RIGHT AT MT. OLIVE CHURCH OFF OF HWY 174. TAKE FIRST RIGHT ONTO DIRT ROAD AT BLACK MAILBOX. GO TO END OF ROAD. SITE IS AT WHITE FRAME HOUSE.

APPLICANT: JOHN DOE
ACTIVITY: BULKHEAD
COUNTY: CHARLESTON
DATE: 3-12-80
SOURCE: USGS - EDISTO ISLAND

Scanawah Island

GEORGIA

JOINT APPLICATION
FOR A DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS, DREDGE & FILL PERMIT STATE OF GEORGIA MARSHLAND PROTECTION PERMIT & REQUEST FOR WATER QUALITY CERTIFICATION AS APPLICABLE

1. Application number

(To be assigned by Corps).

2. Date.

Day Mo. Yr.

3. For official use only.

4. Name and address of applicant. (If location of project is not same as above, indicate Route No., Box No. or other information to assist in locating project).

Telephone number__________________

5. Name, address, and title of applicant's authorized agent for permit application coordination.

Telephone No. __________

6. Describe the proposed activity, its purpose and intended use, including a description of the type of structures, if any, to be erected on fills, or pile, or float-supported platforms, and the type, composition and quantity of materials to be discharged or dumped and means of conveyance.

7. Proposed use.

Private _ Public _ Commercial _ Other _ (Explain in remarks)

8. Name and addresses of adjoining property owners whose property also adjoins the waterway.

9. Location where proposed activity exists or will occur.

County	Military District	In - City or Town
Near - City or Town	Subdivision	Lot No.
Lot Size	Approximate Elevation of Lot	State

10. Name of Waterway at location of the activity. ______________________________

Name of nearest creek, river, sound, bay, island or hammock. ______________________________

11. Date activity is proposed to commence. ______________________________

Date activity is expected to be completed. ______________________________

12. Is any portion of the activity for which authorization is sought now complete?

Yes __ No __

If answer is "Yes" give reasons in the remarks section. Month and year the activity was completed ____________ . Indicate the existing work on the drawings.

If the fill or work is existing, indicate date of commencement and completion.

____

If not completed, indicate percentage completed, date it will be completed.

____

Date of existing structure or work. ______________________________

Give dates when began and when completed. ______________________________

13. List of approvals or certifications required by other Federal, interstate, State or local agencies for any structures, construction discharges, deposits or other activities described in this application.

Issuing Agency	Type Approval	Identification No.	Date/Application	Date/Approval

14. Has any agency denied approval for the activity described herein or for any activity directly related to the activity described herein?

Yes ___ No ___(If "Yes" explain in remarks)

15. Remarks (see paragraph 3 of Permits Pamphlet for additional information required for certain activities).

16. Description of Operation: (If feasible this information should be shown on drawing)

A. Purpose of excavation or fill ______________________________

1. Access channel: length__________depth__________width__________
2. Boat Basin length__________depth__________width__________
3. Fill area length__________depth__________width__________
4. Other ________ length__________depth__________width__________

(Note: If channel, give reason for needs of dimensions listed above.)

B. 1. If bulkhead, give dimensions

2. Type of bulkhead construction (material)

C. Excavated material

1. Cubic yards
2. Type of material

---

17. Land Type, , and Construction Equipment:

A. Does the area to be excavated include any marshland? Yes __ No __

B. Does the disposal area contain any marshland? Yes __ No __

C. Location of disposal area

D. Maintenance dredging, estimated amounts, frequency and disposal sites to be utilized

E. Will dredged material be entrapped or encased?

F. Type of equipment to be used

G. Will marshland be crossed in transporting equipment to project site?
(If yes, explain)

H. Present rate of shoreline erosion (if known)

---

18. Water quality Certification: In some cases, Federal law requires that a Water Quality Certification from the State of Georgia be obtained prior to issuance of a Federal license or permit. Applicability of this requirement to any specific project is determined by the permitting Federal agency. The information requested below is generally sufficient for the Georgia Environmental Protection Division to issue such a certification, if required. Any item which is not applicable to a specific project should be so marked. Additional information will be requested, if needed.

A. Please submit the following:

1. A plan showing the location and size of any facility, existing or proposed, for handling any sanitary or industrial wastewaters generated on your property.

2. A plan of the existing or proposed project and your adjacent property for which Permits are being requested.

3. A plan showing the location of all points where petro-chemical products (gasoline, oils, cleaners) will be used and stored. Any above ground storage areas must be diked and there should be no storm drain catch basins within the diked areas. All valving arrangements on any petro-chemical transfer lines should be shown.

4. A contingency plan delineating action to be taken by you in the event of spillage of petro-chemical products or other materials from your operation.

5. Plan and profile drawings showing limits of areas to be dredged, areas to be used for placement of spoil, locations of any dikes to be constructed, and typical cross sections of the dikes.

B. Please provide the following statements:

1. A statement that all activities will be performed in a manner to minimize turbidity in the stream.

2. A statement that there will be no oils or other pollutants released from the proposed activities which will reach the stream.

3. A statement that all work performed during construction will be done in a manner to prevent interference with any legitimate water uses.

---

19. The applicant must be the owner of the property or be the lessee or have other authority to perform the activity requested. Evidence of the above may be furnished by a copy of the deed or other instrument as may be appropriate. The applicant must have State of Georgia's assent or a waiver authorizing the use of State-owned lands. (See attached letter.)

---

20. Application is hereby made for a permit or permits to authorize the activities described herein. Water Quality Certification from the Georgia Environmental Protection Division is also requested, if needed. I certify that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete, and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant

INSTRUCTIONS FOR COMPLETION OF PERMIT APPLICATIONS

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any fake, fictitious, or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false fictitious or fraudulent statement of entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

The application must be signed by the person who desires to undertake the proposed activity; however, the application may be signed by a duly authorized agent if accompanied by a statement by that person designating the agent and agreeing to furnish upon request, supplemental information in support of the application.

If the activity includes the discharge of dredged or fill material in navigable waters or the transportation of dredged material for the purpose of dumping it in ocean waters, the application to the U.S. Corps of Engineers must be accompanied by a fee of $100 for quantities exceeding 2,500 cubic yards and $10 for quantities of 2,500 cubic yards or less. Federal, State and local governments are excluded from this requirement Check is to be made payable to Treasurer of the United States.

Permit application is to be completed and submitted as follows:

A. One copy of application, location map, drawing, copy of the deed and any other supporting information to:

1. For Department of the Army Permit, mail to:

District Engineer, Corps of Engineers
Department of the Army, Savannah
Attn: Regulatory Functions Branch
P.O. Box 889
Savannah, GA 31402
Phone: (912) 233-8822 Ext.347

2. For Marshland Permit - State of Georgia, mail to:

Coastal Protection Section
Coastal Resources Division, DNR
1200 Glynn Ave.
Brunswick GA 31523

Phone: (912) 264-7365

3. For Executive Department - State of Georgia - Request for assent for use of State-owned lands. (See attached letter.) Mail to:

Mr. James B. Talley, Executive Assistant
Georgia Department of Natural Resources
270 Washington Street, SW.
Atlanta, GA 30334
Phone: (404) 656-3508

4. For Water Quality Certification - State of Georgia, mail to:

Water Quality Certification
Environmental Protection Division
Georgia Department of Natural Resources
270 Washington Street, SW.
Atlanta, GA 30334
Phone: (404) 656-4887

MARSHLANDS PROTECTION

JOINT APPLICATION PROCEDURES

Checklist for Applications:

☐ 1. Name, Address, and telephone number of the applicant and/or the agent.

☐ 2. A brief description of the proposed project together with an explanation of its purpose and intended use (private, public, commercial, other).

☐ 3. A copy of the deed or some other legal instrument which shows proof of ownership or other lawful authority to make use of the property. Refer to Rules 391-2-3-.02 (4) (b).

☐ 4. A list of names and addresses of all landowners who have property adjoining or abutting the tract/parcel of land within which the proposed project is to be located. Refer to Rule 391-2-3-.02 (4) (d).

☐ 5. A certificate or letter from the local zoning authority stating that the proposal is not in violation of any zoning law, ordinance or other local restrictions which may be applicable.

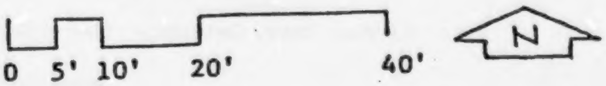
☐ 6. An application fee of $25 (check or money order) made payable to the order of the Georgia Department of Natural Resources for each acre of land or portion thereof to be affected up to $500 for any one proposal. This fee for processing your application is non-refundable.

☐ 7. A list of all certifications required by other Federal, State and local agencies for the work described in the application. Indicate approvals or denials as applicable.

☐ 8 A written explanation of why the permit should be granted.

The following drawings and plans should be submitted on a maximum sheet size of 14" x 18" (smaller sheet sizes are acceptable and encouraged). All drawings should be crisp and clear (preferably not blue line). Use a simple line technique to enhance the clarity of the drawings. All wording, labels and dimensions should be large and dark enough to reproduce clearly when reduced to an 8½" x 11" page. Ensure the accuracy of the drawings' contents through a simple, straightforward graphic approach. Always make sure that drawings are done to scale. Include a bar scale with drawings so that if they are reduced, the scale will read true. Also include a north arrow.

Ex: SCALE: 1" = 20'



☐ 9. A plat showing the boundaries (dimensions and size) of the parcel and proposed project site together with an indication of the adjacent or abutting properties. Elevations should be in mean sea level (MSL).

☐ 10. A plan of the parcel and proposed project site showing both the existing and proposed features. This would include streets, utilities, structures, boardwalks, dredged areas, spoil areas, dikes, bulkheads, retaining walls, rip-rap, significant natural vegetation, introduced landscape materials, significant topographical features, significant drainage patters, etc. Show elevation of project site with respect to mean sea level/mean tide level. This plan will essentially be a detailed Site Plan. Include any element which will help elucidate the proposed project.

☐ 11. A series of construction drawings clearly showing the applicants' proposed project and how that project is to be completed. Include sections and/or elevations which show the proposed project in relation to mean sea level/mean tide level.

○ FOR STRUCTURES: Show details to explain the type and size of structures and where they are to be located. Clearly show whether structure is to be built on FILL, elevated on PILING or placed on FLOAT SUPPORTED PLATFORMS.

○ FOR BULKHEADS, RETAINING WALLS OR RIP-RAP: Show location and extent of work together with dimensions in linear feet. Use a cross-section to show depth, width, profile and cubic yards of material where applicable. Show typical construction method with respect to the tie-backs, footings/foundations, height above mean sea level, type of material (wood, steel, concrete, asbestos sheet, etc.).

○ FOR DREDGE/SPOIL PROJECTS: Show size and location of each activity together with cubic yards of material to be handled. Show the location of any dikes to be constructed with a typical cross-section. Show the project in relation to existing navigation channels. Indicate the estimated amount of maintenance dredging, frequency of maintenance and which disposal sites will be used for the material.

○ FOR FILL/EXCAVATION PROJECTS: Show size and location of each activity together with cubic yards of material to be handled. For fill projects indicate the type, composition and quantity of materials to be utilized. Show the location from which the material will be obtained and the means of conveyance to the site.

○ FOR MARINAS, DOCKS, BOAT RAMPS, FISHERMAN'S CATWALKS, AND ROADS: Show details to explain the type and size of any such structure. Show extent, placement and spacing of support piles. Indicate type of materials to be used; i.e., wood, concrete, steel, asphalt, shell, gravel, etc. Show typical construction methods using plans, elevations and construction details where applicable. For BOAT RAMPS show length, width, slope, materials and access. For ROADS show typical cross-section, culvert placement and size, and extent of bridging and/or elevating. For MARINAS and DOCKS show all associated facilities to be constructed (access, floating docks, fixed docks, boat storage, fuel dispensing, hoists, etc.) For FISHERMAN'S CATWALKS show method of public access and any related work together with construction details.

In addition to these procedural requirements, check to see if thought has been given to the following items.

Yes No

☐ ☐ A. Is the proposed project, if applicable, in the public interest for the benefit of all citizens of Georgia? Is the public interest protected?

☐ ☐ B. If project maintenance will alter marshlands, has it been included in the request for a permit?

☐ ☐ C. Has an analysis of alternative construction methods and/or project sites been conducted?

☐ ☐ D. Is the project water-related and dependent on a waterfront location or is there an upland alternative available?

☐ ☐ E. Does the proposed project violate any local zoning regulations or other local, State, and Federal requirements.?

☐ ☐ F. Will the proposed project create any unreasonably harmful obstruction to or alteration of the natural flow of navigational waters?

☐ ☐ G. Will the proposed project increase erosion or the shoaling of channels?

☐ ☐ H. Will the proposed project create areas of stagnant water?

☐ ☐ I. Will the proposed project interfere with the conservation of fish, shrimp, oysters, crabs, clams or any marine life or wildlife or other natural resources?

☐ ☐ J. Is the amount of marshlands to be altered the absolute minimum necessary to complete the project?

☐ ☐ K. Will any of the proposed structures constitute an unreasonable obstruction of view to adjoining landowners?

☐ ☐ L. Does the proposed project, where applicable, represent an enhancement of the public's access to waterfront locations?

☐ ☐ M. Does the demand for the proposed project, if applicable, justify the alteration of marshlands?

☐ ☐ N. Has there been a demonstrated need for erosion control structures?

☐ ☐ O. Is there protective natural vegetation in place, thereby eliminating or reducing the need for erosion control structures?

☐ ☐ P. Will the proposed project increase turbidity or cause siltation at other locations?

☐ ☐ Q. Will the timing and location of dredging activities take into consideration the movements and life stages of fish, shellfish, and wildlife, expecially during spawning and early development?

APPLICANT'S NAME ______________________
ADDRESS ______________________
____
____

CORPS APPLICATION NO. ______________________

Mr. James B. Talley
Executive Assistant
Department of Natural Resources
270 Washington St., S.W. - Rm. 815
Atlanta, GA 30334

Dear Mr. Talley:

I am making application for a permit with the U.S. Department of the Army, Corps of Engineers, Savannah District. I understand that the issuance of such a permit will not relieve me of the obligation to obtain authorization from the State of Georgia since the proposed project would constitute an encroachment on the beds of tidewaters which are State-owned property. Accordingly, I hereby request that I be granted a revocable license from the State of Georgia. Attached hereto and made a part of this request is a copy of the plans of the project which will be the subject of such a license.

I understand that if permission from the State is granted, it will be a revocable license and will not constitute a license coupled with an interest. I further acknowledge that such a license would relate only to the property interests of the State and would not obviate the necessity of obtaining any other State license, permit or authorization required by State law.

I recognize that I do not have the permission of the State of Georgia to proceed with such project until a copy of this request, which is sent and signed by me in duplicate, is signed by you and returned to me.

Sincerely,

____
(APPLICANT)

The State of Georgia hereby grants you a revocable license not coupled with an interest as provided in your request.

STATE OF GEORGIA
Office of the Governor

By ______________________
JAMES B. TALLEY

FLORIDA

JOINT APPLICATION
DEPARTMENT OF THE ARMY/FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION
For Activities in the Waters of the State of Florida

CORPS APPLICATION NUMBER (official use only)	DER APPLICATION NUMBER (official use only)

1. APPLICANT'S NAME AND ADDRESS

NAME

STREET

CITY STATE ZIP

TELEPHONE NUMBER (Day) ( ) (Night) ( )

2. Name, address, zip code and title of applicant's authorized agent for permit application coordination

Telephone Number ( )

3. NAME OF WATERWAY AT LOCATION OF THE ACTIVITY.

DER Code________
W/W Code________

4. LOCATION WHERE PROPOSED ACTIVITY EXISTS OR WILL OCCUR.

Street, road or other descriptive location

Section Township Range

Incorporated city or town

Latitude Longitude

County

Tax Assessors Description: (if known)

Map No. Subdiv. No. Lot No.

5. NAME AND ADDRESS INCLUDING ZIP CODE OF ADJOINING PROPERTY OWNERS WHOSE PROPERTY ALSO ADJOINS THE WATERWAY.

6. PROPOSED USE
Private Single Dwelling [ ] Private Multi-dwelling [ ] Public [ ]
Commercial [ ] Other [ ] (Explain in remarks)

7. DESCRIPTION OF PROJECT (Use additional sheets, if necessary)

A. Structures: 1. New work [ ] Maintenance of existing structure [ ]

COE Work Code
|___|___|___|

2. Piers, docks and use: Commercial [ ] Private [ ] Public [ ]

a. Single pier [ ] length ____________ width ____________

b. Number of piers [ ] length ____________ width ____________

c. Number of boat slips [ ] length ____________ width ____________

d. Number of finger piers [ ] length ____________ width ____________

e. Other (please describe) ________________________________

3. Seawalls, revetments, bulkheads: length ____________

a. Type: Vertical [ ] Riprap [ ] Slope: ______Horizontal:_____Vertical

b. Material to be used ________________________________

4. Other type of structure ________________________________

B. Excavation or Dredging: New Work [ ] Maintenance work [ ] Total acreage involved ________

1. Access Channel [ ] or Canal [ ] Length ________ft. Width ________ft. Depth ______ft.

2. Boat Basin [ ] or Boat Slip [ ] Length ________ft. Width ________ft. Depth ______ft.

3. Other ________________________ Length ________ft. Width ________ft. Depth ______ft.

4. Cubic yards: Total for project ________________

a. ____________ cyd. waterward/____________ cyd. landward of ordinary/mean high water

b. Type of material to be excavated/dredged ________________________________

C. Fill:

1. Amount of material

DER Code
___253
___403

a. Cubic yards placed waterward of ordinary/mean high water ____________

b. Cubic yards placed landward of ordinary/mean high water ____________

c. Total acreage to be filled __________ Total acreage of wetlands involved ________

2. Containment for fill

a. Dikes [ ] b. Seawall, etc. [ ] c. Other (please explain) ____________

____

3. Type of fill material to be used ________________________________

4. Source of fill material to be used ________________________________

8. Date activity is proposed to commence ______________ ; to be completed ____________________.

9. Previous permits for this project have been DER # Corps #

A. Denied (date) ____________ ____________________ ____________________

B. Issued (date) ____________ ____________________ ____________________

C. Other (please explain) ____

Differentiate between existing work and proposed work on the drawings.

10. Remarks (See Instruction Pamphlet for additional information required for all applications and certain activities. Use additional sheets if necessary.)

11. AFFIDAVIT OF OWNERSHIP OR CONTROL of the property on which the proposed project is to be undertaken

I CERTIFY THAT: (please check appropriate space)

☐ I am the record owner, lessee, or record easement holder of the property described below.

☐ I am not the record owner, lessee, or record easement holder of the property described below, but I will have before undertaking the proposed work the requisit property interest. (Please explain what the interest will be and how it will be acquired.)

LEGAL DESCRIPTION OF PROPERTY SITUATED IN ____________________ COUNTY, FLORIDA
(Use additional sheets if necessary)

____
Signature

Sworn and subscribed before me at ____County,

____________, this ______ day of ____________________, 19__.

____
NOTARY PUBLIC

My commission expires:

12. Application is made for a permit(s) to authorize the activities described herein.

A. I authorize the agent listed in Item #2 to negotiate modifications or revisions, when necessary, and accept or assent to any stipulations on my behalf.

B. I understand I may have to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable State Water Quality Standards or other environmental standards both before construction and after the project is completed.

C. In addition, I agree to provide entry to the project site for inspectors with proper identification or documents as required by law from the environmental agencies for the purpose of making preliminary analyses of the site. Further, I agree to provide entry to the project site for such inspectors to monitor permitted work if a permit is granted.

D. Further, I hereby acknowledge the obligation and responsibility for obtaining all of the required state, federal or local permits before commencement of construction activities I also understand that before commencement of this proposed project I must be granted separate permits or authorizations from the U.S. Corps of Engineers, the U.S. Coast Guard, the Department of Environmental Regulation, and the Department of Natural Resources, as necessary.

I CERTIFY that I am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities.

Signature of Applicant ____________________ Date ____________

NOTE: THIS APPLICATION MUST BE SIGNED by the person who desires to undertake the proposed activity or by an authorized agent. If an agent is applying on behalf of the applicant, attach proof of authority for the agent to sign and bind the applicant.

18 U.S.C. Section 1001 provides that: Whoever in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

NOTICE TO PERMIT APPLICANTS

This is a Joint Application; it is NOT a Joint Permit!

You Must Obtain All Required Local, State, and Federal

Authorizations or Permits Before Commencing Work!!

For your information: Section 370.034, Florida Statutes, requires that all dredge and fill equipment owned, used, leased, rented or operated in the state shall be registered with the Department of Natural Resources. Before selecting your contractor or equipment you may wish to determine if this requirement has been met. For further information, contact the Chief of the Bureau of Licenses and Motorboat Registration, Department of Natural Resources, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303. Telephone Number 904/488-1195. THIS IS NOT A REQUIREMENT FOR A PERMIT FROM THE DEPARTMENT OF ENVIRONMENTAL REGULATION.

ALABAMA

MEMORANDUM OF AGREEMENT BETWEEN
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
AND THE CORPS OF ENGINEERS
RELATING TO SECTION 404 AND SECTION 10 PERMITS

WHEREAS, the Alabama Department of Environmental Management (hereinafter, ADEM) has been designated by Act 82-612 Regular Session 1982 as the State Water Pollution Control Agency and the agency responsible for administering the other regulatory efforts of the Alabama Coastal Area Management Program (hereinafter, ACAMP); and

WHEREAS, the ADEM is, accordingly, the State agency responsible for water quality and coastal resources protection within the State of Alabama; and

WHEREAS, the Department of the Army through the Corps of Engineers (hereinafter, the Corps) has certain responsibilities for issuing permits under Section 404 of the Clean Water Act and Section 10 of the River and Harbor Act of 1899; and

WHEREAS, Section 401 of the Clean Water Act and Section 307 of the Coastal Zone Management Act of 1972, as amended, require that the State establish public notification procedures with regard to State certification of Section 404 permits and Section 307 certifications; and

WHEREAS, the ADEM and the Corps wish to define their duties and responsibilities to one another and to the public pursuant to the Clean Water Act and the Coastal Zone Management Act of 1972, as amended, in order that these projects proceed in a timely manner.

NOW, THEREFORE, the ADEM and the Corps mutually agree as follows:

A. The Corps shall transmit to the ADEM sufficient copies of the information described below to provide for the efficient and timely review of Section 404 and Section 10 applications for water quality and coastal program certification:

- Copies of each permit application
- Copies of each public notice
- Copies of all pertinent correspondence between the Corps, the applicant, other viewing agencies, and the public-at-large

The furnishing of a permit application by the Corps shall be deemed by ADEM to be a request for 401(a) certification and 307 consistency.

B. For all projects that are not Federal projects, by the Mobile District, the Corps agrees to issue a timely Joint Public Notice for the Corps and the ADEM. Such notice shall at least contain the following statement:

1. The applicant has applied for certification from the State of Alabama in accordance with Section 401(a)(1) of the Clean Water Act and upon completion of the required advertising, a determination relative to certification will be made.

Reproduced from best available copy.

2. (If the applicant's project is located within the area under the jurisdiction of the Coastal Zone Management Program.) The applicant has certified that the proposed activity complies with and will be conducted in a manner that is consistent with the State Coastal Zone Management Program. Upon completion of the required advertising, a determination relative to consistency will be made by ADEM.

3. Correspondence concerning this Public Notice should refer to Public Notice Number ____________________ and should be directed to the District Engineer, U. S. Army Engineer District, Mobile, Post Office Box 2288, Mobile, Alabama 36628, Attention: Regulatory Branch, with copy to Director, Department of Environmental Management, State Capitol, Montgomery, Alabama 36130, and a copy to Director, Coastal Program, Suite 10, 3263 Demetropolis Road, Mobile, Alabama 36609.

C. The Corps and the ADEM agree to allow a maximum of 30 days after issuance of a Joint Public Notice on a project for public comment on said project, unless such other public comment period is mutually agreed to by the Corps and ADEM.

D. ADEM shall furnish all certification, denials of certification, waivers of certification or conditions of certification to the Corps no later than 15 days after the expiration of the public comment period unless the Department notifies the Corps that an extension of time will be required to review the project; otherwise state approval may be confirmed verbally. Extensions of time shall not extend beyond the time limits specified in Section 307 of the Coastal Zone Management Act of 1972, as amended.

E. A joint public hearing on permit proposals, consistency, and certification shall be held if the District Engineer and ADEM mutually agree that a valid public interest would be served.

F. Notice of any public hearing on certification, consistency or permit proposals shall be made by the Corps at least 30 days in advance of the hearing date.

G. Copies of any hearing record, as well as comments at such hearing, shall be furnished to ADEM by the Corps.

H. Any conditions necessary to assure maintenance of water quality or to assure consistency with the Alabama Coastal Area Management Program contained in a statement given by the ADEM shall be made an essential part of the Corps permit.

I. If amendments to the permit affecting water quality, consistency with the ACAMP, or time extensions of the permit are needed after issuance, the ADEM will be notified of such proposed changes by the District Engineer. Mobile District will also notify ADEM of any changes in title or transfer of ownership of permits about which the District is informed. The ADEM will evaluate the proposed changes as to possible impact on water quality, and consistency with the ACAMP, and advise the District Engineer within a maximum of 15 days whether or not a new public notice may be needed and its position on recertification.

J. Those "general" permits in effect on September 30, 1982 shall remain in effect until renegotiated on a mutually developed schedule by the ADEM and the Corps.

K. Copies of each permit issued, along with attached conditions, shall be furnished ADEM within 30 days after issuance.

L. In cases of natural disaster or other emergency situations, the Corps will contact the Director of the ADEM as to the need for certification or consistency for rebuilding or emergency construction projects, and where appropriate obtain from the Director such certification, waiver of certification, or statement of consistency.

M. In cases involving an "after-the-fact" application for ADEM certification pursuant to Section 401 of the Clean Water Act of 1977, the ADEM agrees to give an intent to proceed with legal action no later than 15 days after the request for comments by the Corps. If the Director determines legal action will not be pursued, the ADEM will waive Section 401 certification or consistency. If the Director determines legal action is warranted, the Director shall notify the Corps, and then the Corps, the ADEM or both may take appropriate legal action.

N. For applications completed prior to the execution of this Agreement, the Corps shall send to ADEM a request for certification prior to the issuance of the permit. ADEM shall process the request for certification in a timely manner.

O. This Agreement supersedes all previous Memoranda of Understanding or other agreements between the ADEM and the Mobile District Regulatory Branch.

P. Changes in this Agreement shall be made by written amendment hereto.

Q. This Agreement may be terminated by either party by giving notice to the other party of the termination at least 30 days in advance of such termination.

R. This Agreement becomes effective 6 July, 1983.

FOR THE ALABAMA DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT

1 July 83
Date

Joe B Broadwater

FOR THE U. S. ARMY CORPS OF ENGINEERS

31 May 83
Date

Ronald A

for PATRICK J. KELLY, Colonel, CE
District Engineer

MISSISSISPPI

JOINT APPLICATION AND NOTIFICATION

U.S. DEPARTMENT OF ARMY, CORPS OF ENGINEERS
MISSISSIPPI DEPT. OF WILDLIFE CONSERVATION, BUREAU OF MARINE RESOURCES
MISSISSIPPI DEPT. OF NATURAL RESOURCES, BUREAU OF POLLUTION CONTROL

This form is to be used for proposed activities in waters of the United States and Mississippi and for the erection of structures on suitable sites for water dependent industry. Note that some items, as indicated, apply only to projects located in the coastal area of Hancock, Harrison and Jackson Counties.

1. Date

____ ____ ____
month day year

2. Applicant (mailing address and telephone)

3. Official use only
COE ________
BMR ________
BPC ________
A95 ________

DATE RECEIVED
____

4. Project location

Street Address ________ City/Community ________
Name of Waterway ________ Latitude ____ Longitude ____ (if known)
Geographic location Section ____ Township ____ Range ____ County ________

5. Project description
Dredging New work ____ Maintenance work ____
____ Channel length ____ width ____ existing depth ____ proposed depth ____
____ Canal length ____ width ____ existing depth ____ proposed depth ____
____ Boat slip length ____ width ____ existing depth ____ proposed depth ____
____ Marina length ____ width ____ existing depth ____ proposed depth ____
____ Other (Explain) ________

Cubic yards of material to be removed ________ Type of material ________
Location of spoil disposal area ________
Dimensions of spoil area ________ Method of excavation ________
How will excavated material be contained? ________

Construction of structures
____ Bulkhead total length ____ height above water ____
____ Pier length ____ width ____ height ____
____ Boat ramp length ____ width ____ slope ____
____ Other (explain) ________
____ Structures on designated sites for water dependent industry (Coastal area only)
Explain in Item 11 or include as an attachment.

Filling
Dimensions of fill area ________
Cubic yards to fill ________ Type of fill ________

Other regulated activities (i.e. Seismic exploration, burning or clearing of marsh) Explain.

____
____
____

6. Additional information relating to the proposed activity

Does project area contain any marsh vegetation? Yes ______ No ______ (If yes explain) ______

Is any portion of the activity for which authorization is sought now complete? Yes ____ No ____ (If yes explain)

______ Month and year activity took place ______

If project is for maintenance work of existing structures or existing channels, describe legal authorization for the existing work. Provide permit number, dates or other form of authorization ______

Has any agency denied approval for the activity described herein or for any activity that is directly related to the activity described herein? Yes ______ No ______ ______ (If yes explain ______

7. Project schedule

Proposed start date ______ Proposed completion date ______

Expected completion date (or development timetable) for any projects dependent on the activity described herein. ______

8. Estimated cost of the project ______

9. Describe the purpose of the project. Describe the relationship between the project and any secondary or future development the project is designed to support. ______

Intended use: Private ______ Commercial ______ Public ______ Other (Explain) ______

10. Describe the public benefits of the proposed activity and of the projects dependent on the proposed activity. Also describe the extent of public use of the proposed project.

11. Remarks

Provide the names and addresses of the adjacent property owners. Also identify the property owners on the plan view of the drawing described in Attachment "A".

1.

2.

---

13. List all approvals or certifications received or applied for from Federal, state or local agencies for any structures, construction, discharges, desposits or other activities described in this application. Note that the signature in Item 14 certifies that application has been made to or that permits are not required from the following agencies. If permits are not required place NA in space for Type Approval.

Agency	Type Approval	Application Date	Approval Date
Bureau of Pollution Control			
Bureau of Marine Resources			
U.S. Army Corps of Engineers			
City/County ______________________			
Other ___________________________			

---

14. Certification and signatures

Application is hereby made for authorization to conduct the activities described herein. I agree to provide any additional information/data that may be necessary to provide reasonable assurance or evidence to show that the proposed project will comply with the applicable state water quality standards or other environmental protection standards both during construction and after the project is completed. I also agree to provide entry to the project site for inspectors from the environmental protection agencies for the purpose of making preliminary analyses of the site and monitoring permitted works. I certify that I am familiar with and responsible for the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities.

______________________________ ______________________________

Signature of Applicant or Agent Date

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willingly falsifies, conceals, or covers up by any trick, scheme or device a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

---

15. Mississippi Coastal Program Certification (Coastal area only)

I certify that the proposed project for which authorization is sought complies with the approved Mississippi Coastal Program and will be conducted in a manner consistent with the program.

______________________________ ______________________________

Signature of Applicant or Agent Date

16. Fees

Payable to State of Mississippi
$10.00 Application fee
$35.00 Cost of public notice fee

State of Mississippi fee to be included with Application to the Bureau of Marine Resources for Hancock, Harrison and Jackson Counties only.

Payable to Treasurer of the United States
$10.00 Non-commercial projects
$100.00 Commercial projects

Do not submit fee with application.
Fee acceptable only at time of issuance of permit.

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17. Send one completed copy of this application form to each agency listed below:

Bureau Director
Bureau of Marine Resources
P. O. Drawer 959
Long Beach, MS 39560

Bureau Director
Bureau of Pollution Control
P. O. Box 10385
Jackson, MS 39205

If project is in Hancock, Harrison or Jackson Counties send one completed copy of this application and appropriate fees listed in item 16 to:

District Engineer
U.S. Army Engineer District, Mobile
Attn: SAMOP-S
P. O. Box 2288
Mobile, Alabama 36628

District Engineer
U.S. Army Engineer District, Vicksburg
Attn: LMKOD-FE
P. O. Box 60
Vicksburg, Mississippi 39180

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18. In addition to the completed application form the following attachments are required:

Attachment "A" Drawings
Provide a vicinity map showing the location of the proposed site along with a written description of how to reach the site from major highways or landmarks. Provide accurate drawings of the project site with proposed activities shown in detail. All drawings must be to scale or with dimensions noted on drawings and must show a plan view and cross section or elevation. Use 8½" x 11" white paper or drawing sheet attached.

Attachment "B" Authorized Agent
If applicant desires to have an agent or consultant act in his behalf for permit coordination, a signed authorization designating said agent must be provided with the application forms. The authorized agent named may sign the application forms and the consistency statement.

Attachment "C" Environmental Assessment (Coastal area only)
Provide an appropriate report or statement assessing environmental impacts of the proposed activity and the final project dependent on it. The project's effects on the wetlands and the effects on the life dependent on them should be addressed. Also provide a complete description of any measures to be taken to reduce detrimental off-site effects to the coastal wetlands during and after the proposed activity.

Attachment "D" Variance or Revisions to Mississippi Coastal Program (Coastal area only)
If the applicant is requesting a variance to the guidelines in Section 2, Part III, or a revision to the Coastal Wetlands Use Plan in Section 2, Part IV of the Rules, Regulations, Guidelines and Procedures of the Mississippi Coastal Program a written request and justification must be provided.